

PC MAGAZINE

THE TECH
BENEATH
THE VIDEO
STREAMING
WORLD

MEET THE
BIG PLAYERS

THE NEW ENTERTAINMENT GIANTS

HOLLYWOOD

COVER STORY THE NEW ENTERTAINMENT GIANTS

Welcome to the content-industrial complex.



FEATURES

MEET THE BIG PLAYERS

With all the old and new players, it can be hard to wrap your head around the sheer scope of this market. We break it down for you, company by company.

THE TECH BENEATH THE VIDEO STREAMING WORLD

Underneath the shows, movies, and live events is an amalgam of interwoven technology.

WHAT'S NEW NOW



BEST OF MWC19

Our favorite products from the gigantic mobile show.

JIGSAW CHROME EXTENSION TUNES OUT INTERNET TOXICITY

This experimental extension runs on machine learning.

5 REASONS FOLDABLE PHONES ARE A BAD IDEA

This technology isn't ready for prime time.

ORIGAMI-INSPIRED ROBOT GRIPPER COULD PACK YOUR GROCERIES

The gripper collapses around an object like a Venus flytrap.

THE WHY AXIS



REVIEWS

CONSUMER ELECTRONICS

Leica Q2

Fitbit Versa Lite

Sonos One (Gen 2)



Leica Q2

HARDWARE

HP Spectre x360 13 (2019)

Digital Storm Lynx

SOFTWARE & APPS

Transparent Language Online

SOS Online Backup



Sonos One (Gen 2)



Digital Storm Lynx

COMMENTARY

CAROL MANGIS

First Word

READER INPUT

BEN DICKSON

**Is iOS Secure After
FaceTime Bug Fix?
No One Knows**

CHANDRE STEELE

**When Will There
Be a #Me2.0?**



**Even if you're
not a woman in
technology,
Silicon Valley's
innovations can be
used against you.**



– STEELE

TIPS & HOW TOS



GET ORGANIZED: 10 TIPS FOR REMOTE JOB INTERVIEWS

Our advice can help give you an advantage.

HOW TO SPOT FAKE NEWS ONLINE

It's still pervasive; here's how to sort out the wheat from the chaff.

10 WAYS TO BOOST YOUR WI-FI SIGNAL

These simple tips can help optimize your network.



The New Streaming Wars

Do you remember the days before cable, when pretty much all you could watch on television were ABC, CBS, NBC, PBS, and a few weird and fuzzy channels on the UHF band? I might be giving too much information away here, but I grew up during those days.

Despite the limited options, my brother and I watched TV—a lot. After school, after dinner, Saturday morning (cartoons!), and whenever else we could convince our parents to let us. That says a lot about the hypnotic attraction of the screen. TV—even early, low-res TV—is where screen addiction started for a lot of us.

Today, of course, we have multiple screens to watch, both at home and when we're on the move. Everything looks a lot better than it used to. And the amount of broadcast and video content that's available now would have been unimaginable 40 or 50 years ago.

But don't blink: The evolution of the entertainment-media landscape is picking up its pace. With recent consolidations of major networks and other providers and more tech companies jumping into the game, consumers are about to get a whole lot of additional choices—maybe more than they can handle.

Right now, you're likely coughing up the cash for cable, Netflix, and maybe a couple of other streaming services. What about when Disney's

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streaming service arrives? Maybe it'll be a must-have for your family. How about the upcoming WarnerMedia, a mashup of HBO, Warner Bros., and Turner? It might be hard to pass that up. How much is your video entertainment budget going to increase within the next few years? Don't ask.

Our cover story this month escorts you through the rapidly changing world of streaming video. Writer Rob Marvin talked to executives at Amazon Prime Video, CBS, Disney, and Hulu, as well as expert industry analysts, to understand and illustrate the escalating war for original content and other huge shifts taking place. He also introduces a lineup of today's big entertainment-media players and includes a tech primer on how all this content is being delivered to your many screens.

Readers, please bear in mind that all these things are changing on a daily basis! In fact, Apple's streaming announcement came just as we closed the issue. But we made these stories as up-to-date as we could. We hope you'll enjoy reading them as much as you enjoy streaming video.

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Who's Really Leading in 5G?

A PCMag survey found that most Americans believe Apple is the leading phone vendor when it comes to 5G.

That's a little shocking, because most observers believe Apple is going to introduce 5G phones a full year later than Android phone vendors. Actually, those 2019 "5G phones" are really "5G-ready" but not "5G-usable" this year.

They will have the first version 5G modems inside, but true 5G cellular service won't be available in most places until at least 2020 (if not later). There is no rush for Apple to put 5G modems in its 2019 iPhones, and (as rumored) they will include second-generation 5G modems in their 2020 iPhones... when they are actually usable.

—*Jurassic*

Apple has never (well, since Jobs took it back over) been an actual technical innovator. It's just been good at assembling extant technology and marketing it as breakthroughs.

Not to say that Apple hasn't introduced "new" things that changed how we look at tech; just that others do the real inventing, and then Apple packages it.

—*Fairportfan*

For whatever reason, the tech media loves to pretend 3rd place Apple matters more than they do. Which is hilarious considering how meaningless Apple is. They could disappear completely tomorrow and they don't make a single product the world can't replace instantly.

—*Reality Check*

Apple has a history of not releasing technology in its products until it has been solidified. The exception to this is when [it is] pushing for a new standard that it can control. 5G is dependent on the carrier rollout, not on Apple providing a device to operate on that technology. Therefore, it is not advantageous to release a 5G device until the networks can truly handle it.

—*MJB*

Ask us a question!

Have a question about a story in *PC Magazine*, one of the products we cover, or how to better use a tech product you own? Email us at letters@pcmag.com and we'll respond to your question here. Questions may be edited slightly for content and clarity.



The Best of MWC19

BY PCMAG STAFF



We go to a lot of trade shows throughout the year, but Mobile World Congress definitely holds a special place in our hearts. Maybe it's the setting—Barcelona is magical—or maybe it's the fact that every year, the show manages to bring together a consistently impressive roster of new products.

If MWC had a theme for 2019, it's hard to say whether that would be 5G or foldable phones (or 5G foldable phones?), which made a big splash and feature prominently on this list. But our seven favorite products reach beyond the trends, representing the absolute best of what the industry has to offer for the year ahead.



HUAWEI MATE X

Best Phone

One phone absolutely stole the show this year: the Huawei Mate X. In addition to being the most attractive folding phone we've seen to date (sorry, Samsung Galaxy Fold), it's also the only one with 5G. When folded, the Mate X is a dual-screen phone with a 6.6-inch

primary display on the front and a 6.4-inch secondary display on the back. Unfold the phone, and you have an 8-inch tablet that's just 0.2 inches thick.

It's not all good news, though. Pricing for the Mate X starts at a staggering 2,299 euros (approximately \$2,600), and it will not be sold in the US.

—Steven Winkelman



LG V50

Best 5G Phone

MWC was full of 5G phones this year, but for PCMag readers, we think the LG V50 is the sweet spot. For one thing, it's going to be released in the US and available from multiple carriers. For another, it feels like a good standard phone rather than an oversized one. It's

about the same size as LG's existing V40, just a bit heavier—unlike the Samsung Galaxy S10 5G, which is kind of a monster phablet. And the V50 doesn't lack innovation: Its unique dual-screen case turns it into a “folding” phone that's going to be far more affordable than the \$2,600 Huawei Mate X.

One carrier that will offer the V50 is Sprint, which gave us the most no-nonsense 5G announcement of all the carriers at the show. Sprint showed us the first potential 5G coverage maps and promised coverage in named cities during a particular month (May), not during a vague quarter or half of a year. The LG V50 makes 5G real for US consumers.—Sascha Segan



NOKIA 4.2

Best Low-Cost Phone

Nokia has really started to make a name for itself in the international budget phone market, and 2019 might be the year it claims the crown in the US. After announcing two carrier partnerships in January, the Finnish company debuted the Nokia 4.2 at MWC19.

Starting at \$169, the phone can easily be mistaken for a high-end flagship model. It has an all-glass body and a 5.71-inch display with an 18:9 aspect ratio. There's a dual camera module and a fingerprint sensor on the back, although you may not need the latter since the phone also has facial authentication. Like nearly all of Nokia's smartphones, the 4.2 is part of the Android One program and will ship with Android 9.0 Pie when it comes out this spring.—SW



LENOVO THINKPAD T490S

Best Laptop

Lenovo's new ThinkPad T490s is a thin and light 14-inch business laptop. That ordinarily wouldn't make it anything special, but the T490s combines legendary ThinkPad durability and comfort in a sleek, 2.81-pound package with a rated 20 hours of battery life and very thin borders around its 14-inch, 1440p screen. It does all this at a starting price of \$1,279, which

means that it's more affordable than the ultra-premium Lenovo ThinkPad X1 Carbon. Put all this together, and you get a road warrior's best friend. It goes on sale in June.—Tom Brant



MICROSOFT HOLOLENS 2

Best Augmented Reality Headset

When we think about what 5G is going to eventually be good for, the HoloLens 2 is at the top of the list. Microsoft's first stab at augmented reality was fascinating, but frustrating and limited by an extremely small field of view. The HoloLens 2 solves the original

model's key problems. It's lighter and more comfortable. It has full-hand tracking to let you manipulate virtual objects freely as if they are real, and eye tracking to make your surroundings respond to you. And its 52-degree field of view is the best in the industry, finally creating a usable AR landscape.

At \$125 per month or \$3,500 per unit, the HoloLens 2 isn't a consumer device. But it's well within the reach of businesses who want to add augmented reality to their workflows.—SS



HTC 5G HUB

Best Smart Home Device

It seems like everyone found a way to integrate 5G into their products at MWC this year, and smart home devices were no exception. But the HTC 5G Hub stood out for being one of the more practical (and versatile) home gadgets at the show. It connects to Sprint's 5G

network to provide Wi-Fi to up to 20 devices. It can also stream 4K video directly to its own 5-inch screen. Its compact frame packs a powerful Snapdragon 855 processor, runs Android 9.0 Pie and includes a large 7,660mAh battery that can also charge other devices.

With its simple plug-and-play setup, you can place the Hub anywhere in your home or even take it with you on the go. While it's not a smart speaker, it

supports Google Assistant, so you can use its built-in microphone for voice commands. Further down the line, you'll also be able to use it to stream VR content from the cloud to an HTC Vive headset.—*Brenda Stolyar*



SANDISK EXTREME MICROSD UHS-I 1TB

Best Accessory

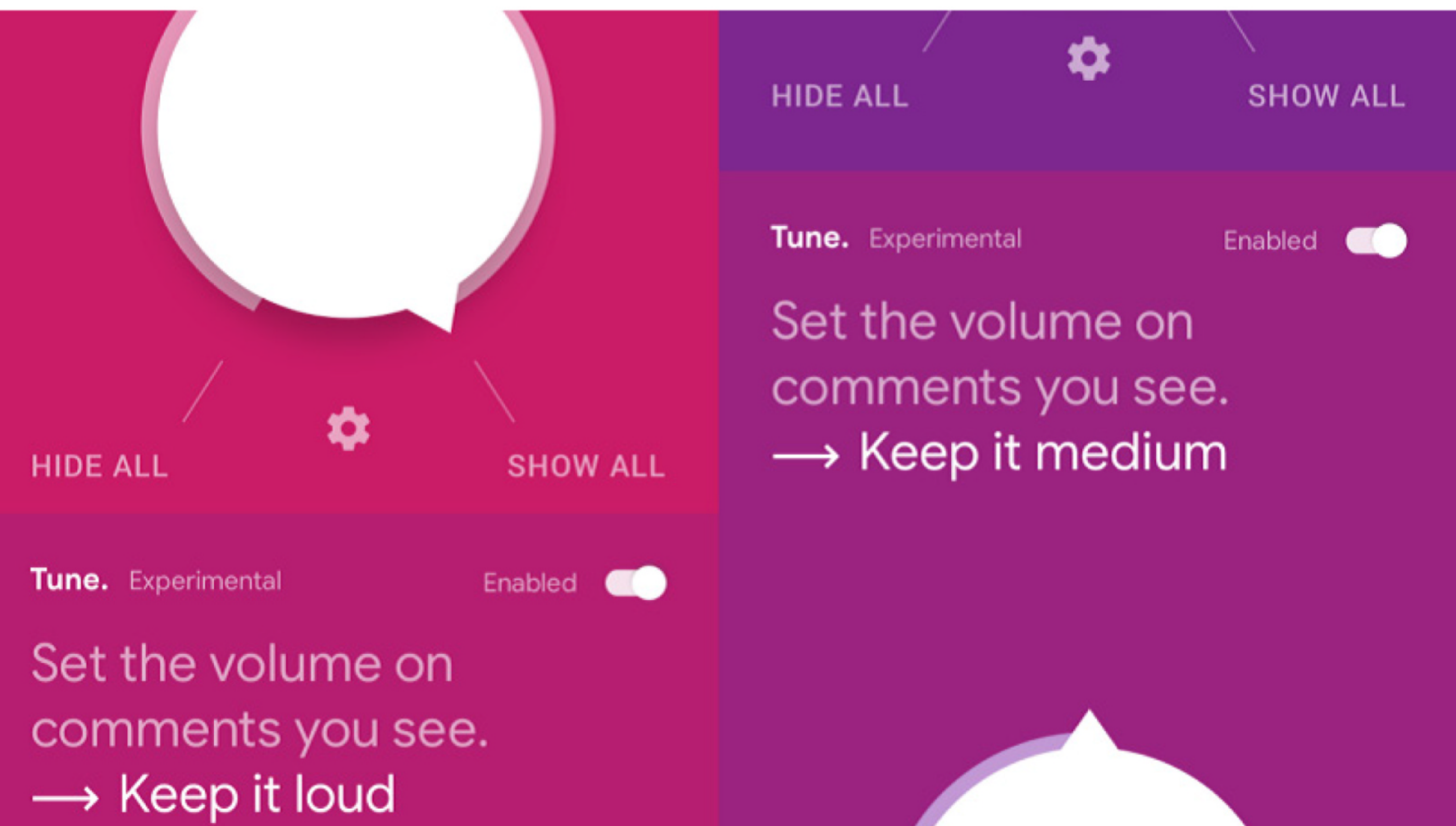
Carriers talk about getting rid of local storage in the 5G era, but the result may be just the opposite—people are going to be downloading huge files to watch offline. Even now, 4K video has started to gobble up memory. SanDisk and Micron just pushed the microSD card to a

new limit, which means you can have a ton of built-in storage in your Samsung Galaxy S10—or, more likely, add a 1TB card to a less-capacious model to bulk it up at a lower price than buying a model with more storage would cost.

SanDisk's card is faster than Micron's, at 160MBps as compared with 100MBps, so it sets the new standard for mobile storage.—*SS*

Jigsaw Chrome Extension Tunes Out Internet Toxicity

BY ROB MARVIN



What if you could turn a dial and tune out an abusive tweet in your Twitter mentions or an insulting comment on Facebook?

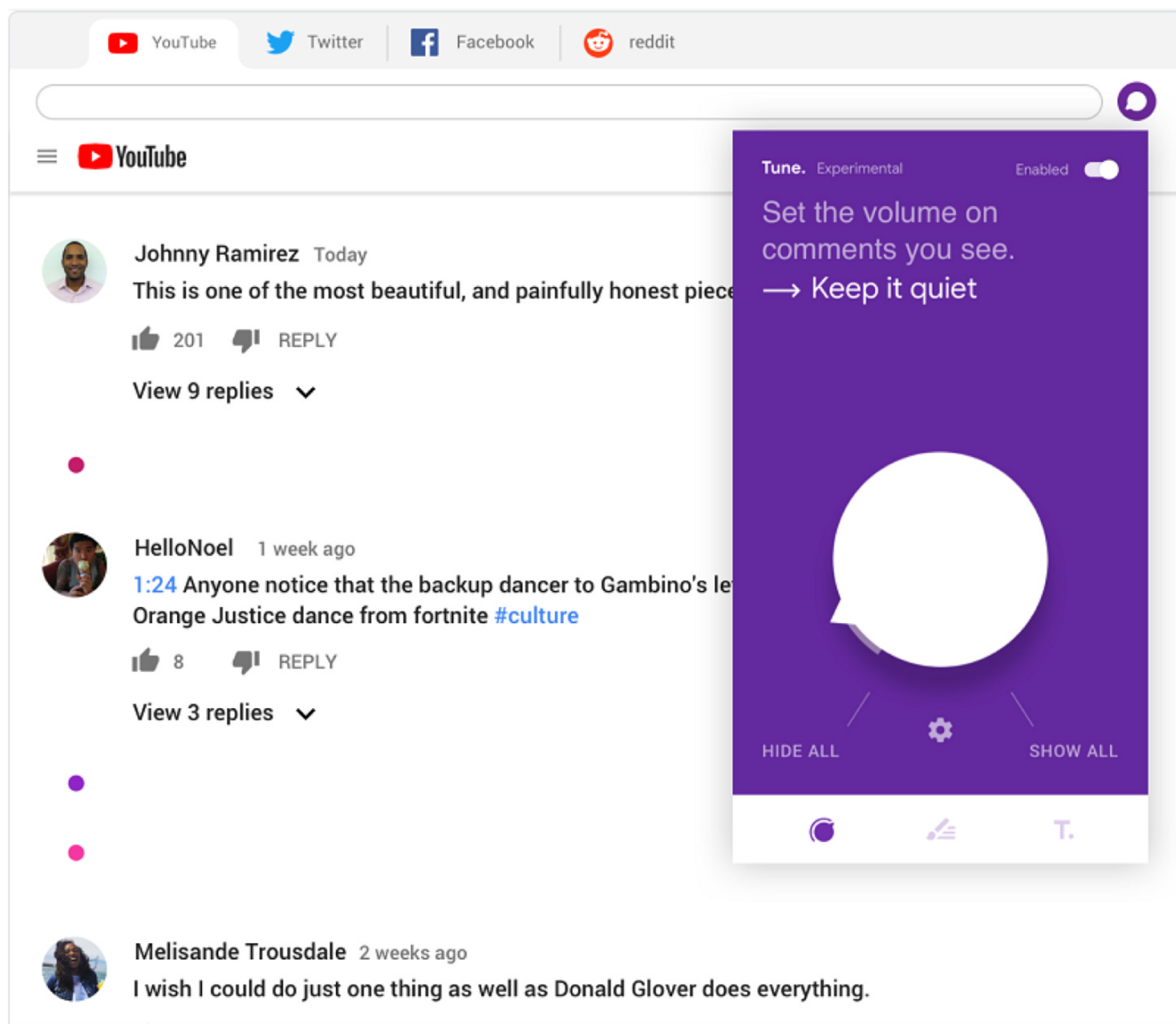
Google's sister company Jigsaw has released an experimental Chrome browser extension called Tune, which lets users control how much "toxicity" they want to see in comments across the internet. Tune is built on Perspective, Jigsaw's API that trains machine learning (ML) models to identify and score comments that could be perceived as abusive or harassment.

At launch, the browser extension works across social media sites including Facebook, Twitter, YouTube, Reddit, and comment platform Disqus. It acts as a

knob that lets users set the “volume” of conversations. Turn it up to see everything, or turn it down all the way to “zen mode” to replace toxic comments with small colored dots.

When I spoke to Perspective product manager CJ Adams for PCMag’s exclusive look inside Jigsaw’s efforts to combat online abuse and harassment, Tune was still in development. But Adams gave me some insight into how Jigsaw was thinking about the Chrome extension extending Perspective’s ML modeling to users.

“It’s about letting viewers who don’t want to sift through 10,000 comments or posts or tweets skip the toxicity by turning this dial down or turning it up to see it all. We want to give them that control,” said Adams.



Until this point, Perspective’s technology has been tested and implemented largely as an assistive AI tool to help content moderators—at sites including *The New York Times*, Wikipedia, *The Guardian*, and *The Economist*—wade through the daily deluge of comments. Perspective can customize ML models to a site’s community guidelines to help filter out the trolls.

Jigsaw also worked on a pilot program with Reddit’s r/ChangeMyView subreddit and has since helped the sub’s founders spin out their own website and more deeply integrate the Perspective API. It’s currently in private alpha testing and will soon launch as a public beta.

The other use case is leveraging Perspective as a proactive tool for authors to improve conversations. The API can scan comments before they’re posted, popping up a message that might read “Before you post this, be sure to remember our community guidelines” or “The language in this comment may violate our community guidelines. Our moderation team will review it shortly.” Perspective’s toxicity scores are an indication not of severity but of probability: higher scores represent a higher likelihood that patterns in the text resemble patterns in comments people have tagged as toxic.

Neither of those applications of the technology addresses the places rife with the worst online abuse and harassment: social media.

Rather than work with Facebook, Twitter, and YouTube directly on another form of AI-assisted content moderation, Jigsaw wanted to give users that control. Social platforms already have countless algorithms running to flag and filter inappropriate content, but time and again they’ve proved woefully inadequate. Human moderation comes with a steep emotional cost as well, as *The Verge* chronicled in a recent exposé on the lives of third-party Facebook content moderators.

Tune is a test to see what happens when you take part of the onus off the platforms and let users decide for themselves, curating what they see based on their own preferences and perceptions.



**Perspective
can
customize
ML models
to a site’s
community
guidelines to
help filter out
the trolls.**



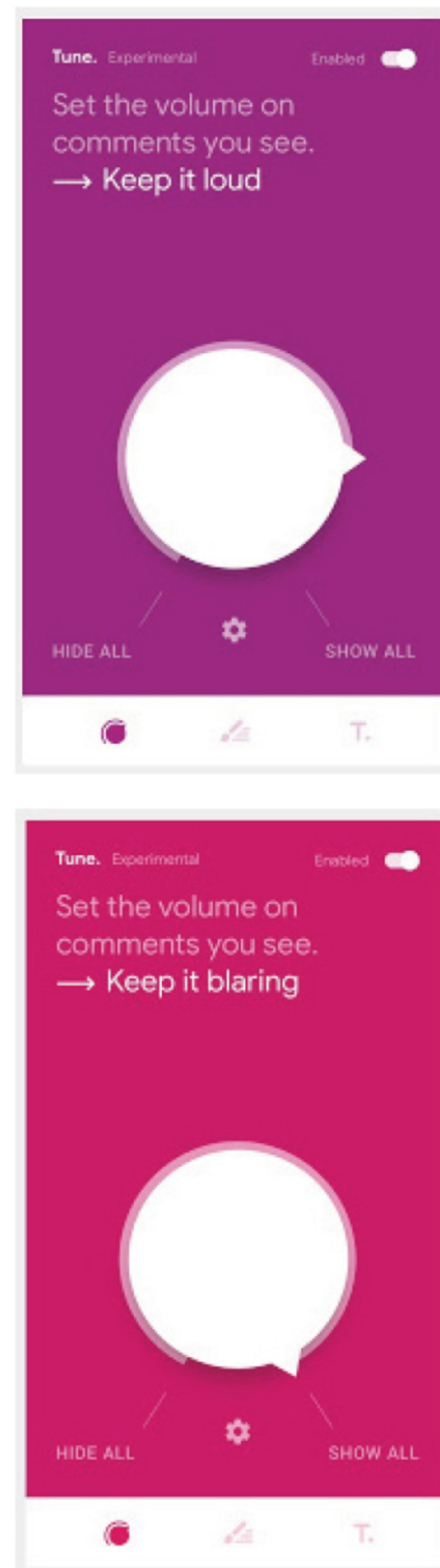
The first experimental version of the Chrome extension has a few different default settings, including “loud,” “medium,” and “zen mode.” Turning the dial all the way down skips comments completely, while leaving the extension on full blast means the content you see on Facebook, Reddit, Twitter, or YouTube won’t be filtered at all. Putting the dial somewhere in the middle gives users more granular control over which comments, insults, and profanity, they want to see as the Perspective API continues to learn and improve its toxicity modeling.

The team stressed that Perspective’s ML is imperfect and experimental; that’s why this is not an official Google product. Perspective still misses and miscategorizes toxic and non-toxic comments. Jigsaw has gone through years of trial-and-error in developing and testing a tool designed for the inherently subjective task of classifying the emotional impact of language.

The Perspective team hopes this crowdsourced Chrome experiment will help improve the technology and that the open-source nature of Tune will inspire developers and show how AI can improve online conversations.

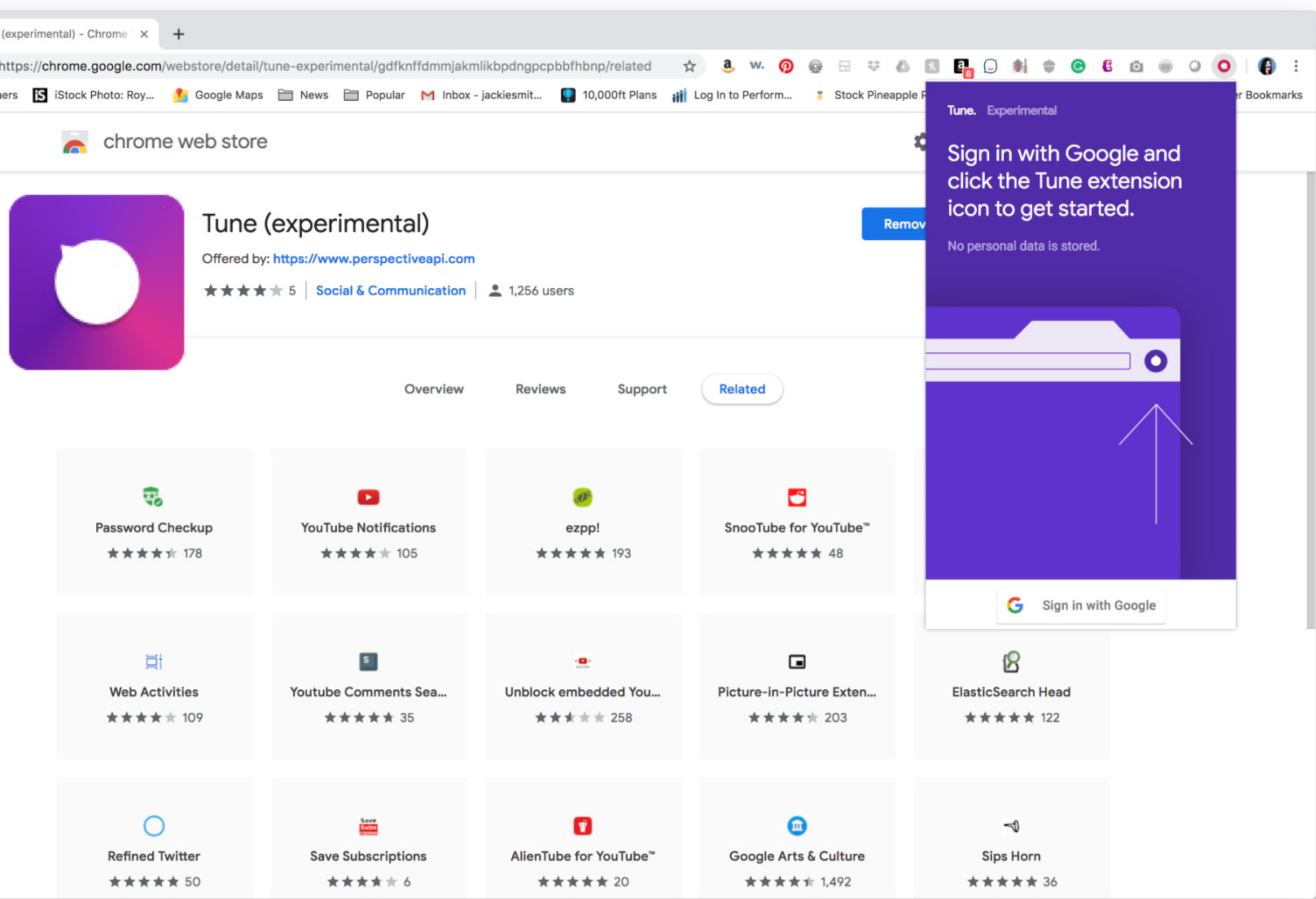
“There are other examples of Perspective’s technology being used this way,” said Adams. “There’s an extension to promote the movie *Wonder* about a kid getting bullied. That extension uses Perspective to let kids browse the internet and cover up abusive comments with high toxicity scores and replaces them with a motivational message you can view if you want or skip. Tune is just a more elegant, open-source version of that.”

Jigsaw also stressed that Tune isn’t meant to be a solution for direct targets of harassment, for whom blocking abusive comments might be detrimental to their safety. The more philosophical question with this kind of technology, especially when it’s brought directly to users through a browser extension, is whether tuning out content or comments you don’t want to see improves conversations or fragments them.



Social media allows people to surround themselves with like-minded individuals who largely confirm rather than challenge beliefs. Perspective and Tune are designed to bring people of all political and ideological stripes back into conversations, according to Adams, by giving them a space to disagree meaningfully online.

But if you make it easier for people to tune out the online noise they don't like—even if a lot of it is hate speech, harassment, and trolls—these sorts of AI tools have the potential to make the internet even more of an echo chamber.



5 Reasons Foldable Phones Are a Bad Idea

BY RYAN WHITWAM



Smartphones used to come in all shapes and sizes: phones with keyboards, rotating cameras, 3D screens. Smartphone design has standardized around the flat glass slab in recent years—but things are starting to get weird again. Multiple smartphone makers seem to think 2019 is the time to make science-fictional folding phones a reality.

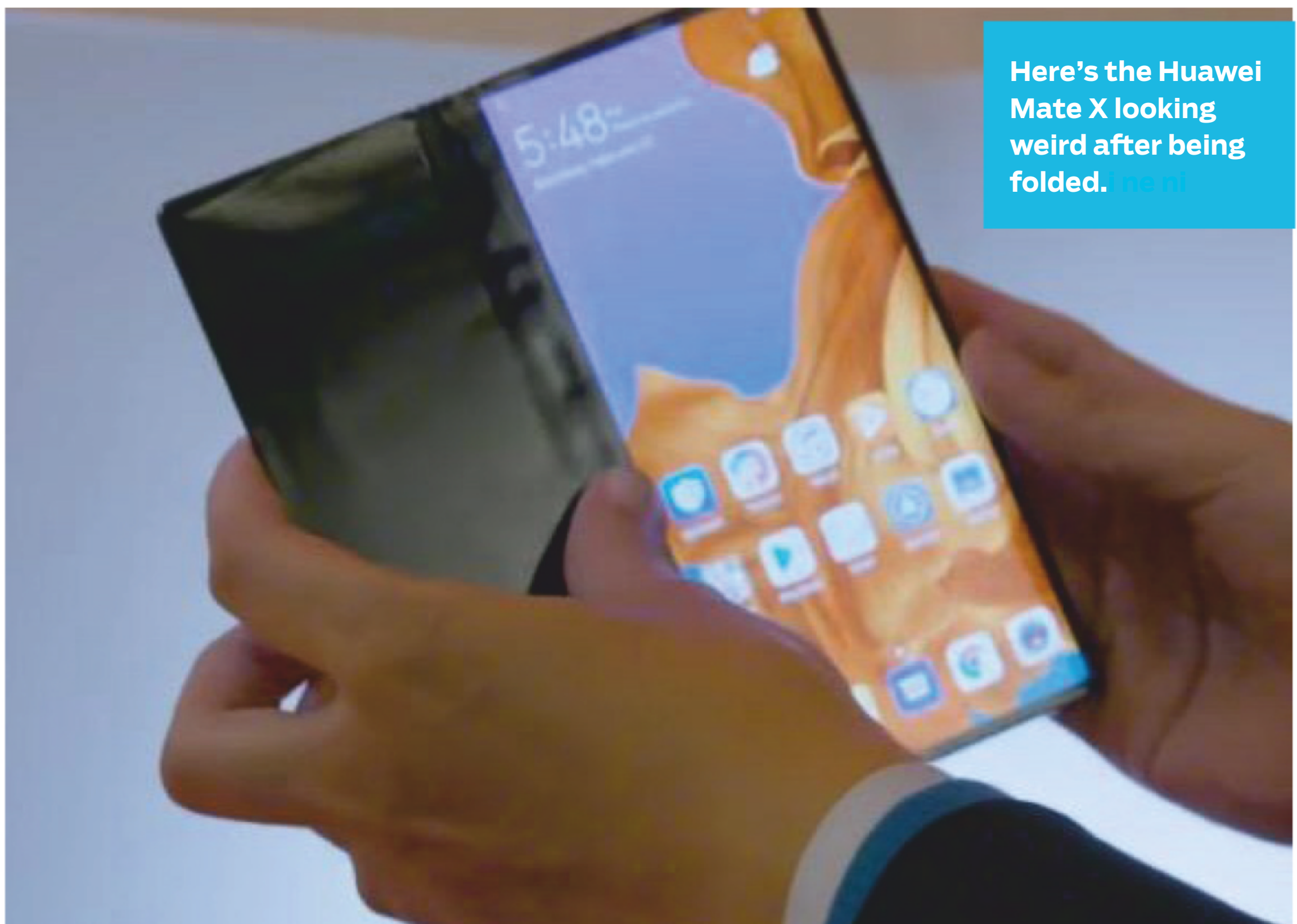
Devices such as the Samsung Galaxy Fold and Huawei Mate X look cool in demos, but foldable phones are probably a long, long way from being any good. Here are five reasons the current crop of devices is going to be bad.

EVEN “NICE” PLASTIC SCREENS ARE STILL PLASTIC

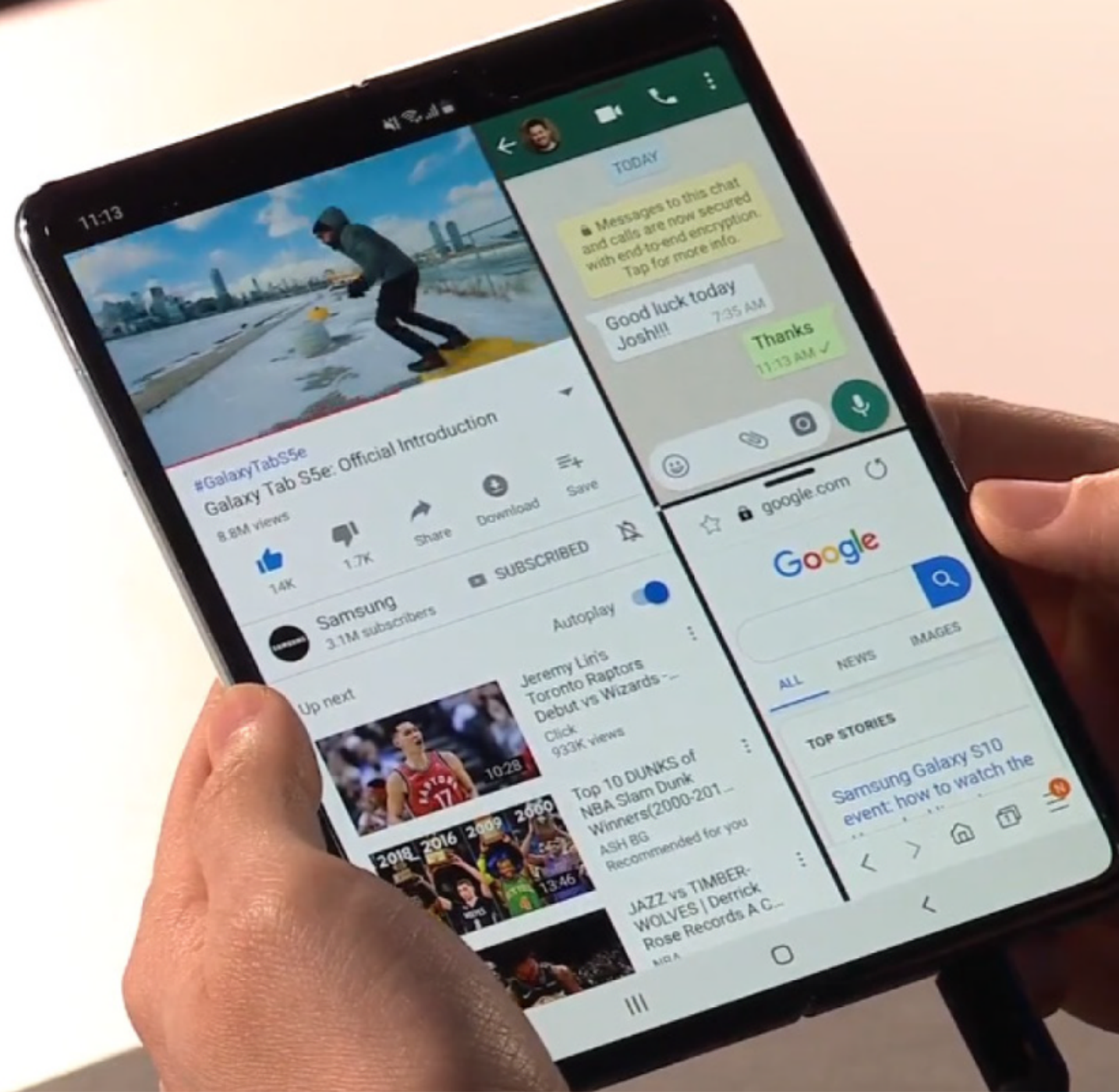
Everyone thought Apple was crazy to put a big glass screen on the original iPhone, but that turned out to be a good idea. Glass adds to the structural strength of your phone, and modern hardened glass is very difficult to scratch. But foldable phones are plastic, because there's no such thing as folding glass (at least, not yet).

A lot of things are harder than plastic, but few are harder than Gorilla Glass. While your flat smartphone can ride around in your pocket or bag with keys, pens, and coins, a foldable phone might come out looking like a scuffed mess. Oh, your phone folds inward, like the Galaxy Fold? Good luck never getting dust trapped in there when you close it.

You might also have noticed Samsung and Huawei are cautious about how they demo these new foldables. That's because they're hiding how weird the screens can look. As more people get hands-on with the phones, it has become clear that the plastic covers have creases down the middle, and that might get worse over time. The texture of the screen is also uneven, with undulating ripples from repeated folding and unfolding. This is more obvious when you see the screens from an angle.



Here's the Huawei Mate X looking weird after being folded. [The Verge](#)



THEY WILL BREAK EVENTUALLY

Perhaps you think the plastic-screen tradeoff is no big deal. At least the screen won't shatter when you drop it, right? Well, don't count on foldable phones being particularly durable. All folding phones include a complex hinge system that's going to fail eventually, and we've been through this before. Consumers progressively shied away from phones with hinges, sliders, and other moving parts because they broke at a much higher rate than devices that are just a chunk of metal and glass.

Maybe the folding bits of these phones will last for thousands of cycles on average, but that's the average. Some of them won't. Samsung talked up its custom geared-hinge system, which does look impressive. Still, the more moving parts you add, the more likely something is to break. There are already enough factors making phones disposable. We don't need to add more.

APP SUPPORT WILL NEVER ARRIVE

Before you spend the cash on a foldable phone, you have to first think about why you'd want one. Do you really need a tablet in your pocket all the time? Don't expect miracles. Android apps didn't work well on tablets, and there's no reason to think this will be any better with foldables.

Android foldables will support new split-screen modes that look neat in demos. Most people don't need three live updating apps visible simultaneously. They just need one app that works well on the screen.

Android foldables will support new split-screen modes that look neat in demos. But most people don't need three live updating apps visible simultaneously. They just need one app that works well on the screen. Google will give developers some half-baked tools to make apps work better on folding phones, and next-to-zero apps will be updated. So you're just back to the classic problems with Android tablet apps.

One of the primary drivers in making phones larger is video playback, and foldables don't help with that. Well, unless you really like black bars.

THE DESIGNS ARE STILL CLUNKY

Converting your phone into a tablet is the selling point of foldables, but how often will people really do that? If you want to carry what is essentially a tablet all the time, you can just buy a tablet. We can safely assume anyone using a foldable phone will use it folded most of the time because it's easier to hold. But these phones all look like absolute bricks, and there's no reason to expect that to change anytime soon.

The Galaxy Fold is a whopping 17mm thick when closed. If you're wondering what that'll feel like, just tape two regular phones together. Even with all that girth, the battery capacity is only a tiny bit larger than that of a conventional phone. The slightly more svelte Mate X is still 11mm thick, and one edge remains that thick when you unfold the screen.



With a foldable, you're trading all the ergonomic niceties of modern phone design so you can unfold your device into a tablet a few times per day. That's not a good tradeoff.

THEY COST TOO MUCH

Being an early adopter means higher prices, as companies roll out new materials and technologies. For example, the Samsung Note Edge with the first curved OLED cost about 20 percent more than the regular Galaxy Note of that era. Apple charged about 30 percent more for the iPhone X when it launched alongside the iPhone 8.

The price bump for a foldable phone in 2019 isn't 20, 30, or even 50 percent: These phones are more than twice as expensive as the current top-of-the-line flat smartphones. Samsung is asking about \$2,000 for the Galaxy Fold, and the Mate X will be even more at around \$2,600. These are not reasonable prices for consumer (or even luxury) electronics. The obscene pricing is a sign that foldable phone technology isn't ready for prime time. Yet companies are pushing it on us like this is the next big thing. In reality, it's years away from viability.



Being an early adopter means higher prices, as companies roll out new materials and technologies.



Origami-Inspired Robot Gripper Could Pack Your Groceries

BY MATTHEW HUMPHRIES



Photo by Jason Dorfman- MIT CSAIL

Robots continue to become more agile, able to cope with more varied environments and complete complex tasks, but they still struggle when it comes to picking up delicate objects without causing damage.

A team of researchers at MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL) have come up with a solution, though, and they have origami to thank for it.

Rather than trying to copy the human hand, MIT professor Daniela Rus, director of MIT's CSAIL, and a team of researchers from MIT and Harvard created a new gripper. It's cone-shaped and collapses around an object, similar to the way a Venus flytrap works. The gripper is hollow and vacuum-powered, with inspiration coming from Uri Shumakov's origami magic ball.

Rus is aiming to create a robot that can pack your groceries, which means it has to be able to pick up such disparate objects as apples, soup cans, wine bottles, and boxes of detergent. The gripper goes a long way toward achieving this: It can collapse around most shapes without damaging what is being held. It's also capable of lifting over 100 times its own weight, meaning everything sold at a grocery store is within its grasp, so to speak.



The three main parts of the gripper are an origami skeleton, an airtight skin, and a connector to the robot allowing for control of the vacuum. It's cheap to manufacture and can easily be tweaked to allow for different object-gripping scenarios. It's great at picking up cylindrical objects but struggles with anything flat—although if a flat object is presented at an angle so the corner can be grabbed, the gripper should be able to cope.

The research team believes the new gripper has the potential for use on production lines or in facilities such as Amazon's warehouses, where thousands of different-shaped objects have to be selected and packed.

When Will There Be a #Me2.0?

Two years into wider recognition of the #metoo movement, the tech industry has remained resolutely retrograde. If it were any other measurement of accomplishment, the idea of being far behind innovation would be anathema to leading technology companies—but it's just business as usual when it comes to the treatment of women.

Well before Harvey Weinstein was rightfully excoriated and became the face of what is so wrong about so much for women in the workplace, tech had the opportunity to be at the forefront of a movement. But the industry has put off its moment since 2012, when Ellen Pao sued Kleiner Perkins Caufield & Byers; since 2013, when TechCrunch founder Michael Arrington was accused of abuse by a former girlfriend (which she recanted when he sued her because, according to her lawyer, she “did not want to endure the expense of further litigation”); since 2014, when Andy Rubin stepped away from Google for a reported \$90 million after sexual misconduct charges; since 2015, when a former Google engineer tweeted about the sexual harassment she faced there; since 2016, when



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Sequoia Capital (a company that did not want to “lower [its] standards” by seeking out women to hire) let go of a partner when he was accused of sexual abuse; since 2017, when Susan Fowler wrote about her sexual harassment at Uber; and since 2018, when Microsoft was sued for 238 incidents of sexual harassment, including mishandling rape charges.

Not only do the men involved in these suits sidestep consequences, but they are also often rewarded financially. Just a few months ago, Mike Cagney, who ran SoFi, a company synonymous with sexual harassment, was given \$120 million for a new venture. This is at a time when the gender pay gap in the industry averages 16 percent and the equity gap is over 50 percent.

Women looking to close that gap can join organizations like Ladies Get Paid, where they’ll find tools and resources they can use in salary negotiations and a community of women who share their struggles... and men’s rights activists who have sued to be in the same room.

They can join a co-working space like The Wing, an environment where women can network, receive support, and form startups... and also be among men’s rights activists. I would embed tweets from women disappointed about that, but I don’t want to subject them to ugly harassment.

Because even if you’re not a woman in technology, Silicon Valley’s innovations can be used against you. Your mileage may vary, from rude comments and rape threats on social media

to full-on Gamergate-style assaults on your life, and corporations allowing the complete control of women's lives, as Google and Apple are doing by supporting an app used by men to monitor women in Saudi Arabia.

An ideal place to address these wrongs in the industry would be in a talk at an industry conference. This is, of course, if the conference does not hold its networking event at a strip club, have a panel on the deployment of date-rape drugs, or invite only men to speak.

I won't suggest a corrective, because I don't know the cause. Until men in this industry can examine why they participate in such behavior or give it a pass when they see others do it, change can only be incremental. I do know that companies that continue on this path are ceding the future to others.

chandra_steele@pcmag.com



Not only do the men involved in these suits sidestep consequences, but they are also often rewarded financially.



Is iOS Secure After FaceTime Bug Fix? No One Knows

Apple recently fixed one of the worst security bugs ever discovered in iOS, which allowed a FaceTime caller to hear what people were saying before they answered the call. So what went wrong, and can we prevent another similar disaster?

Apple doesn't make the source code for its operating systems and apps publicly available. Only the company's own engineers, developers, and quality assurance staff test and fix errors in its applications. And Apple requires its employees to sign stringent non-disclosure agreements about its products. This walled-garden approach means that we must trust Apple to deliver secure products.

That said, Apple has one of the most robust software development processes around. Its reputation is backed by more than four decades of delivering secure and reliable applications and products. But once in a while, the failures of security through obscurity—depending on secrecy to ensure security—hit home. The FaceTime bug was an example.



Ben Dickson is a software engineer who writes about disruptive tech trends, including artificial intelligence, VR and AR, the IoT, and blockchain. Ben also runs the blog Tech Talks.

Compared to complicated security bugs that require resources and expertise to discover and exploit, the FaceTime bug was trivial. In fact, it was discovered by a 14-year-old who was playing Fortnite with his friends.

But it raises a question: How could a company with the integrity of Apple miss such an obvious flaw in one of its most-used applications? Was it intentionally caused by a disgruntled employee who wanted revenge? Was it a government-implemented backdoor? Was it an honest, one-in-a-million mistake that could have slipped through the defenses of even the most trustworthy company?

It's hard to answer that question independently. We have to rely on whatever information Apple gives us. And so far, Apple hasn't said much except that it has fixed the flaw in iOS 12.1.4 and will be rewarding the Arizona teenager who first reported the glitch.

We'll also probably never know when the exploit began. According to reports, the bug applied to all devices running iOS 12.1 or later. Released on October 30, 2018, iOS 12.1 added Group FaceTime, the feature that contained the eavesdropping bug. But it's hard to imagine that a bug out in the open running on hundreds of millions of devices would remain undiscovered for several months. Maybe the bug was introduced more recently, as the Apple development team made updates to FaceTime's server-side software. Again, we won't know unless Apple tells us.

In contrast, many organizations have an open-source policy, releasing the full source code of their applications on platforms such as GitHub and making it available for anyone to review. Independent experts and developers can then verify the application's security.

The practice has become increasingly popular in the past few years and has even attracted some historically tight-lipped participants.

A great example of transparency is the secure messaging app Signal. Open Whisper Systems, the company that develops Signal, has published the source code of all versions of its application on GitHub. The entire history of the app's source code, its contributors, and the changes made to the app are visible to everyone. Signal's source code has been reviewed by hundreds of experts and has earned the approval of industry leaders such as Bruce Schneier, Edward Snowden, and Matt Green.

Does this mean that open-source applications have no security flaws? Far from it. Applications with hundreds of thousands of lines of code are complex creations and hard to secure, no matter how many eyes review the code.

In fact, Signal has churned out a few nasty bugs of its own, including one that would let hackers steal your chats in plain text. But in contrast to closed-source apps such as FaceTime, anyone can easily track the source and reasons for flaws in apps such as Signal, as well as when they originated and which code change or new feature caused them. But in the case of the FaceTime bug, we'll have to speculate.

Transparency establishes trust. Obscurity destroys it.

Leica Q2

\$4,995.00



Leica Q2: An Excellent Indulgence



The Leica Q was one of our favorite cameras in 2015. The concept is simple—a bright, sharp, wide-angle lens, paired with a full-frame image sensor, in a body small enough to pack for travel, but not too small where handling is compromised. Its sequel, the Q2, adds weather protection, upping the appeal as a travel camera, and just about doubles the sensor resolution, giving you plenty of room to crop shots from the 28mm f/1.7 lens. It's expensive, but it also delivers the level of quality you expect from Leica and earns our Editors' Choice.

SMALL DESIGN CHANGES

The Q2 doesn't stray far from the look and feel of the original Q, with the same basic form factor. It measures 3.2 by 5.1 by 3.6 inches (HWD), weighs about 1.6 pounds, and features a sturdy metal exterior shell wrapped in leatherette.

The camera slides comfortably into the hand. The leatherette boasts a tight, diamond pattern that gives it a slightly rough feel but also keeps the camera more secure in your grip. There's a rear indentation that serves as a thumb rest. The Q2 ships with a black leather neck strap. If you want a bit more camera to hold, you have options. Leica sells both a traditional handgrip that screws into the tripod socket on the bottom, as well as a rear thumb rest.

Even though it's very similar on the outside, Leica told me that the internals had to be completely redesigned to allow for the seals that add weather protection to this model. Many cameras are claimed to be protected against dust and splashes, but makers don't tell you how well they're sealed. Leica has gone the standards route with the Q2, and the camera is certified to IP52 standards, which protects the camera from water spray coming in at an angle less than 15 degrees from vertical. In layman's terms, you shouldn't be concerned about using the Q2 in rainy conditions, but take care during heavy precipitation, and don't ever think about submerging it.

Leica Q2

PROS High-resolution full-frame image sensor. Quick, accurate autofocus. Bright, sharp lens. Optical stabilization. IP52 weather protection. Big, sharp EVF. Up to 20fps capture. 4K video. Wi-Fi.

CONS Expensive. Doesn't track subjects at top burst rate. No flash.



The lens is the same optically stabilized 28mm f/1.7 prime used by the first Q and the more premium Q-P (\$4,995), both of which use 24MP image sensors. The Q2 has a 47.3MP sensor, which gives you much more leeway when cropping. The lens supports 49mm front filters. A metal lens hood is included; it attaches via an external thread.

TACTILE CONTROLS

The lens is a modern autofocus design, but doesn't really feel like it: In the hand, it feels like a classic, mechanical design. There's a physical aperture ring at the front. It has settings for automatic control (A), as well as detents to shoot at f/1.7, f/1.8, or from f/2 through f/16 at third-stop increments.

The lens also has two control rings, both related to focus. To switch from autofocus to manual focus, you depress a small button that's part of the finger rest that protrudes from the focus ring, and then focus as you would with a manual lens. The focus ring turns with enough resistance to allow for smooth, fine adjustments.

The second focus control is the Macro ring. When it's disengaged, the camera is able to focus from about 11.8

Leica's pricey Q2 camera marries a superb lens to a high-resolution image sensor and puts it all in a travel-friendly package.

The lens is a modern autofocus design, but in the hand, it feels like a classic, mechanical design.



inches (0.3-meter) through infinity. But if you want to work closer, twisting the ring moves the lens elements forward and reveals a second distance scale. In the Macro range, the Q2 focuses from 6.7 inches (0.17-meter) through about 11.8 inches (0.3-meter), at a maximum f/2.8 aperture. It's a neat design that adds a little bit of versatility to the bright, wide-angle lens.



Top controls are all situated to the right of the hot shoe—the Q2 doesn't have a built-in flash. The shutter speed dial is first. It offers settings from 1 through 1/2000-second, and also has an Automatic position to put control into the hands of the camera. The shutter release sits directly in line with the rear thumb rest. It's a standard two-stage design but doesn't include a thread for a soft release or remote cable. Like the first Q, the power switch surrounds the shutter, but Leica has made a change here. The Q2's power switch has positions for On and Off, but not one to switch to burst shooting. That function has been moved to a menu screen.

The lone control dial is at the rear right edge of the plate. The Q2's edges are rounded, and Leica has positioned the dial so it forms one of the curves. By default, the dial provides direct EV adjustment when shooting in aperture or shutter priority, and sets the f-stop when you've got both shutter and aperture dials to the A position. In full Manual mode, it doesn't do anything.

But you can dive into the menu and set it to always adjust the EV compensation setting. That's what I did—the Q2 has a huge range of ISO options, and I don't like to give up the ability to dial in EV adjustments when shooting with manual f-stop and shutter settings but with automatic ISO control enabled.

The dial has a button at its center, another change from the Q. It's quite useful, with a vast array of programmable functions—if you don't like what you see in the default list, you can pop into the menu and change what's available. A total of eight options are available to choose from at any one time—I set the button to adjust the focus area.

Rear controls are minimal. Rectangular Play, Fn, and Menu buttons sit to the left of the rear display. Fn has the same level of programmability as the control dial's central button. There's a four-way directional pad, with a center button, to the right of the LCD.

The rear display is touch-sensitive, and the touch interface supplements physical controls. If you're using a focus mode where you can set the point manually, you can do so by tapping anywhere on the screen, and a double tap brings the focus box back to the center of the frame. Pinch and swipe gestures are supported during playback as well, although you can't navigate through menus via touch.

My real complaint with the Q2's screen is its lack of articulation. While viewing angles are quite good—you can see what's on it even when looking from the side, top, or bottom—not having some sort of tilt means you'll need to get down low on the ground to properly frame a low shot. I love to capture images from lower angles, and it's more of a struggle with the Q2 than with a camera with a tilting display.





The Q2's rectangular buttons, sitting to the left of the rear display, match the design motif of other recent Leica cameras. Fn has the same level of programmability as the control dial's central button.

The Q2 doesn't have a lot of direct competition—the forthcoming Zeiss ZX1 and the Sony RX1R II are the other full-frame, fixed-lens cameras on the market. The RX1R II does have a tilting rear LCD—without touch support—and if you're a fan of the low-angle look, it may be a better fit for you than the Q2. But I think the Q2's wider 28mm lens is a lot more useful than the 35mm f/2 used by Sony and Zeiss in their takes on the concept.

The original Q had a good EVF for the time, but it doesn't look quite as good when compared with more recent cameras. The Q2's EVF is a noticeable upgrade, and it's spectacular. The older LCD tech has been shoved away in favor of OLED, which shows truer, deeper blacks and refreshes more smoothly. It's big—the magnification rating is 0.76x, similar to what you find in a good full-frame mirrorless camera—and sharp at 3.68 million dots. It's the viewfinder you'd expect a \$5,000 camera to have.

There is a diopter adjustment for the EVF. It's a small dial, recessed into the body, just to the right of the eyecup. To adjust it, push it in and the dial will pop out from the body so you can turn it. Once you've dialed in an adjustment to match your vision, push it back in—and there's very little chance it will be changed inadvertently.

FOUR LENSES IN ONE?

There is one additional, unmarked button on the rear. It's located near the top, just to the left of the thumb rest. It controls the Q2's digital zoom setting. It's something the original Q had as well, but its functionality was limited by its 24MP resolution. Here, with 47.3MP to work with, the Q2 can crop to 35mm at 30MP, 50mm at 15MP, and 75mm at 7MP.

In all instances the crop is applied only to JPG files—Raw files retain the full swath of information. Certain Raw workflow software, including Adobe Lightroom Classic CC, will mask the file to the cropped angle of view when it's first loaded, but you can open up the crop to the full 28mm angle of view with a couple of button presses.

Leica rangefinder devotees will love how the Q2's digital crop works from a capture perspective. Instead of cropping the angle of view of the frame, the camera projects frame lines that show what your 35mm, 50mm, or 75mm shot will look like. The ability to see the action happening outside the frame is beloved by rangefinder owners, and it's what you'll enjoy with the Q2 when shooting at a focal setting narrower than 28mm.

One thing you sacrifice when cropping is the extremely shallow depth of field you get when shooting with a longer focal length. Even when shot wide open, the Q2 is going to give you the depth of field from a bright 28mm lens—shallow, but not to the same level of a 50mm f/1.7 or 75mm f/1.7. The Q2 doesn't quite give you four lenses in one, but it's not too far off.

CONNECTIVITY AND POWER

The Q2 has Wi-Fi for file transfer and remote control. It works with Leica's Fotos app, a free download for Android or iOS. I've not yet had a chance to try out the Q2's Wi-Fi—I reviewed the camera ahead of its announcement and a new build of the software was not yet ready. I did take a look at the Fotos app with another recent release, the M10-D. The user experience should be similar to if not identical with the Q2's Wi-Fi system.

The Q2 uses a different battery than its predecessor, upping the expected battery life from 270 to 370

“
**Leica
rangefinder
devotees will
love how the
Q2's digital
crop works
from a
capture
perspective.**
”



images. It now uses the same BP-SCL4 that powers the Leica SL. Spare batteries are pricey, at \$250 each, and I wasn't able to find any third-party alternatives.

A wall charger is included. The Q2 doesn't have a USB or power delivery port, so you won't be able to replenish the battery in-camera. It does have a single memory card slot with support for the latest UHS-II SDXC media, as well as older SD and SDHC cards. We recommend using a 300MBps card for the best performance, as the 47MP files are quite big. Raw images are about 85MB in size, so a card with a lot of storage space is recommended as well.

RESPONSIVE, ACCURATE FOCUS

The Q2 delivers all the speed you'd hope for. It starts, focuses, and fires off a shot in about 1.6 seconds, and its autofocus system is able to acquire a target in under 0.05-second in most light. In very dim conditions it does slow down, but still grabs focus in about 0.3-second.



A number of autofocus options are available. You can choose automatic selection, with or without the aid of face detection; you can use a center point only; or you can opt for a flexible spot you can move around yourself or a flexible spot that tracks subjects.

I prefer using either the wide area or a flexible spot. The Q2's face detection is hit or miss. The face has to be prominent enough in the frame to engage it, and it struggles to identify faces in profile. But it's something that can't really hurt to turn on when you're working with the wide focus field and know you'll want to lock onto the humans in a scene.

I'd like to see some improvement in recognition, as well as a quick way to change which face is being identified. When multiple faces are in a scene, the camera will put a yellow box around the one on which it's focusing and a white box on others. There's no way to switch between them manually—doing so with a tap on the screen or a press of the d-pad would be a welcome addition.

In addition to focus pattern, the Q2 can be set to single (AF-S) or continuous (AF-C) acquisition. In AF-S, the focus is set once it's been found, while AF-C searches for focus as long as you hold the shutter down at its first stage, and reliably nabs a focused shot when you press it fully. There is a lot of wobble—the lens finding and losing focus in rapid succession—which is a result of the contrast-based autofocus system. It's disconcerting, but the Q2 doesn't fail to find proper focus in practice.

Burst shooting is available, too. You can fire off shots at 20fps with the electronic shutter or 10fps with the in-lens mechanical leaf shutter. The duration is limited—when working at 20fps you get 13 Raw+JPG or Raw shots, or 21 JPGs, before the buffer fills. At 10fps expect to get 15 Raw+JPG or Raw images, or 24 JPGs. The time to clear the buffer to a SanDisk 300MBps UHS-II card is about 34 seconds when shooting in Raw+JPG or Raw, and about 9 seconds for JPG.

If you want to track moving subjects while firing the shutter continuously, you'll need to lower the burst rate. The Q2 does a very good job keeping images in focus at its medium speed setting, a perfectly fine 6fps.

HIGH-RESOLUTION IMAGING

The fixed 28mm f/1.7 prime lens is a very good performer. At its widest f/1.7 aperture, it notches 3,230 lines on a center-weighted Imatest evaluation. That's better than the 2,750 lines we want to see at a minimum



I'd like to see some improvement in recognition, as well as a quick way to change which face is being identified.





from a high-resolution image sensor by a decent margin, placing the lens squarely in good performance range. The central area is the sharpest (3,803 lines), but the lens meets or betters 3,200 lines through most parts of the frame. The very outer edges are a bit soft (2,508 lines), which is worth remembering if edge sharpness is important for a particular shot.

There's an uptick in resolution at $f/2$ (3,459 lines), though there's no real improvement at the edges of the frame. At $f/2.8$ we see the average land at 3,535 lines—just into our very good range—and edges settle in at an acceptably crisp 2,978 lines.

At $f/4$, the average score is better yet (3,691 lines), and edges approach 3,300 lines. It's not perfectly even edge-to-edge performance, but it's pretty close. Peak performance is achieved at $f/5.6$ (3,778 lines). Diffraction starts to cut into resolution at $f/8$, but we still see 3,594 lines there. The Q2 puts up 3,279 lines at $f/11$ and 2,724 lines at its smallest $f/16$ aperture.

The lens is optically stabilized. You can set the stabilization system to be on or off in the menu system or to kick in automatically when the shutter speed drops below 1/60-second. I had it disabled for lab tests—the camera is set on a tripod and the self-timer is utilized for all lab work—but used it for all of my field testing. When working with a high-resolution image sensor, every extra bit of stabilization helps to get a better overall image. You'll sacrifice some detail in the corners with the stabilization system turned on, but nothing worth writing home about.



The lens shows slight barrel distortion (1.1 percent), which is nominal for a bright 28mm design. Likewise, there is a slight drop in corner illumination at f/1.7 (-0.9EV), but for most images the vignette will be all but unnoticeable. We didn't observe any chromatic aberration or color fringing. The Q2's image sensor is the same basic 47.3MP full-frame design used by the Panasonic S1R. Leica told us there are some changes—the protective glass cover is omitted from the design, as it's unnecessary in a fixed-lens camera, for one.

The Q2 offers an ISO 50 through 50000 sensitivity range, which is a plus for photographing at wide apertures in bright sunlight. The mechanical shutter can fire as quickly as 1/2,000-second, and a fully electronic shutter kicks in when a shorter exposure is required.

I used Imatest to measure the noise visible in the Q2's default JPG output. It keeps noise under 1.5 percent through ISO 6400, and shows just 1.6 percent at ISO 12500. A very close look at photos from our ISO test scene shows the Q2's image quality is just as good at ISO 800 as it is at ISO 50. There is some very slight loss of crispness around the edges of fine detail at ISO 1600 and 3200.

These sharp edges get a little soft at ISO 6400 and start to appear smudged at ISO 12500. The effect increases at ISO 25000, though the finest details are still somewhat distinct. That's not true at ISO 50000, where smudging gives way to blur. If you plan on using the top sensitivity settings, think about shooting in Raw format, which takes the noise-reduction factor out of photos and gives you more leeway to fine-tune color, pull details out of shadows, and curb highlights when editing on your computer or tablet.

The Q2's Raw output is rife with detail and shows little noticeable noise through ISO 3200. We saw some visible grain starting at ISO 6400, but there was no

loss of detail. The grain is rougher and fine details suffer a little bit at ISO 12500. At ISO 25000, many of the finest details in an image disappear, giving way to even rougher grain. Noise increases at ISO 50000, giving images a very rough appearance.

You shouldn't have to push the Q2 to its extremes too often. I used the camera for some nighttime photography in New York's Washington Heights neighborhood and, even with a minimum 1/80-second shutter speed, I didn't go higher than ISO 6400.

GOOD VIDEO, BUT...

The Q2's video capabilities are pretty impressive on paper. It can record in 4K UHD at 24 or 30fps and supports the wider 4K DCI format at 24fps. It also has 1080p support, at 24, 30, 60, or 120fps.

I tried out both the 4K DCI and 1080p options. In both cases, the video looks crisp and detailed, with the punchy colors you expect from Leica. You do have the option of giving video a different look in-camera—options include Standard, Vivid, Natural, Monochrome Natural, and Monochrome High Contrast.

There's no flat video profile, but that's not a huge surprise. The Q2 doesn't have the microphone input or clean HDMI output that pros look for.

That said, the Q2's video is very serviceable. I'd recommend leaving the camera in AF-S mode or pulling focus manually, as engaging AF-C gives footage a slightly wobbly look, especially noticeable if the lens is actively trying to change the plane of focus.

The optical stabilization does a decent job of keeping handheld footage steady, though it struggles to when



I used the camera for some nighttime photography in New York's Washington Heights neighborhood.



working handheld in the macro focusing range, and it doesn't do a great job when moving around. Typically, cameras that employ sensor-shift stabilization do better to compensate for footsteps.

I missed having a Record button. Leica removed it from the Q2, combining its function with the shutter. It makes switching between video and imaging something you have to think about—and I accidentally started recording a video when I meant to snap a still a few times, simply because I forgot to switch the mode back.

THE LUXURY EDITORS' CHOICE

It's easy to write off the Leica Q2 as a fashion accessory for the elite. Leica cameras have a certain cachet, and one simply needs to point at the pricing of its many limited-edition cameras—for example, the \$18,500 M Edition 60 we tried out a few years back—to cement that belief.

But Leica makes real photographic tools, and the Q2 is a stunning one. It's not quite as versatile as a camera with swappable lenses; you can't put an ultra-wide angle lens on as you can with an M rangefinder, and the sensor resolution does drop quite a bit when using the 75mm crop setting.

But the Q2 isn't as bulky as an SLR, a mirrorless camera, or even an M10 rangefinder and a few lenses. It's not a pocket camera, but it's a less daunting prospect to pack for a vacation or to grab to carry with you on a morning walk about town.

The high-resolution sensor adds some dimension to the Q2 that was missing from the 24MP Q. You can crop down to 50mm and still have plenty of resolution to print, and 75mm is more than adequate for Instagram. The addition of weather sealing broadens the appeal for travelers.



I won't pretend that the nearly \$5,000 asking price is within reach of most photographers—even those who really love the idea of the Q2. So yes, this is a luxury item. It's also one that's extremely capable in making images, is largely a joy to use, and yes, can be a conversation piece.

I like it better than its closest competitor, the \$3,300 Sony RX1R II. The Q2's ergonomics and build quality are better, and I prefer the 28mm focal length to the 35mm lens Sony chose for the RX1 series.

If you love the idea of the Q2 but simply find it too expensive, options are out there. We like the Fujifilm XF10 as a budget alternative—it doesn't handle as well and omits an EVF, but it's the least expensive APS-C sensor compact we've seen to date. There's also the Fujifilm X100F, which sells closer to \$1,300 and sports a 35mm equivalent lens.

But if you can afford it, the Leica Q2 will serve you well. It's an indulgence, but it's also a firm Editors' Choice.

JIM FISHER



I won't pretend that the nearly \$5,000 asking price is within reach of most photographers, even those who love the idea of the Q2.





Fitbit Versa Lite: Entry-Level and Affordable

The Fitbit Versa is one of our favorite smartwatch/fitness tracker hybrids, and at \$199.95, it offers a lot of value for your dollar. But not everyone needs a watch that can count their laps in the pool or store their music. If that includes you, you can save \$40 with the \$159.95 Versa Lite, which provides everything you need to track your health and fitness on a daily basis, minus a few of the more advanced features you get in the standard Versa model.

That makes it a good option for beginners, whether you're looking for a fitness tracker, a smartwatch, or a little bit of both.

Fitbit Versa Lite

\$159.95



A FAMILIAR DESIGN

I'm a fan of the original Versa's sleek styling and comfortable design, so I'm happy that the Versa Lite mostly looks and feels identical. Like Samsung's Galaxy Watch Active, it comes in one case option that looks good on wrists of all sizes. Colors include a silver aluminum case with a white silicone strap, a silver case with a lilac strap, a blue case with a blue strap, and a mulberry case with a mulberry strap. I tested the mulberry model, which is a beautiful and vibrant shade of purple, but not the most practical color for everyday wear. To tone it down, I paired it with a gray silicone wristband. Additional silicone bands and hybrid woven bands range from \$29.95 to \$99.95. All Versa accessories are compatible with the Lite.



The biggest design difference between the Versa and the Versa Lite are the buttons on the sides of the case. While the Versa has two buttons on the right side of the case and one on the left, the Lite has only the one button on the left. A short press brings you to the previous window, and a long press provides quick access for turning the display on, turning notifications on or off, and controlling music. Most of the watch is controlled using the touch display, so the single button actually helps to simplify navigation and make it easier for beginners to get the hang of things.

Fitbit Versa Lite

PROS Lots of features for the price. Sleek, lightweight design. Long battery life. Easy to use.

CONS No on-device music storage. Sleep tracking is a bit finicky.

Speaking of the display, the Versa Lite's aluminum case surrounds a 1.34-inch squarish LCD framed by thick bezels. With a resolution of 300 by 300 pixels (the same as the original), content looks crisp and bright. For the most part, swiping across the screen feels swift and responsive, though I sometimes encountered hiccups on the main dashboard screen and with an influx of notifications to scroll through.

FEATURES AND BATTERY LIFE

Although Fitbit is synonymous with fitness trackers, it's worth restating that the Versa Lite is also a smartwatch. It runs the Fitbit 3.0 operating system and is compatible with Android and iOS. It connects to your smartphone via Bluetooth to show calls, text messages, and calendar

“The single button actually helps to simplify navigation and make it easier for beginners to get the hang of things.”



alerts; using the Fitbit app, you can specify what will send you notifications. And with an Android phone, you can use Fitbit's quick replies to send answers to texts directly from the watch itself.

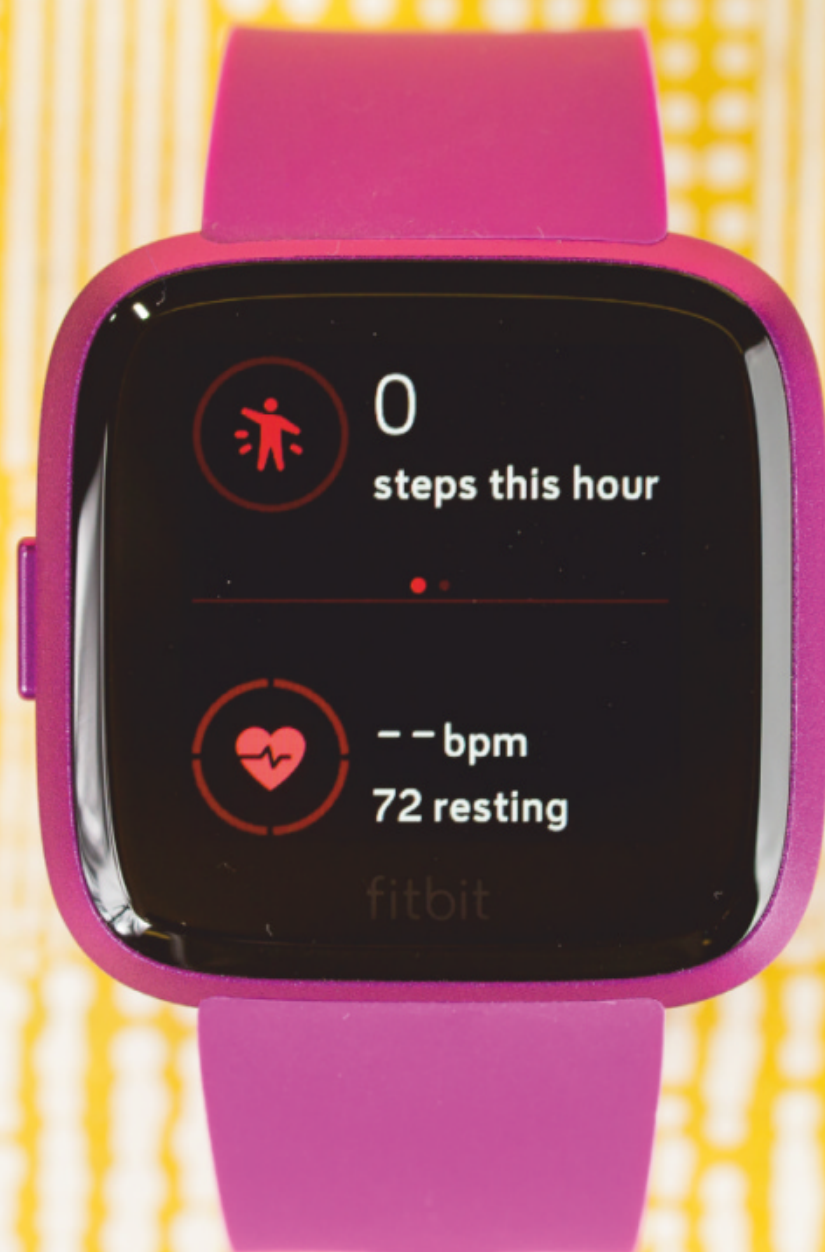
Similar to Samsung's Tizen OS, the interface is organized, intuitive, and easy to grow accustomed to.

Swipe down on the screen for notifications, swipe to the left for apps, and swipe up for your dashboard to check your progress.

As for downloadable third-party apps, Fitbit's store is home to Couch to 5K, Deezer, Flipboard, Pandora, Philips Hue, Starbucks, Strava, and more. While this library isn't as extensive as those of Google's Wear OS or Apple's watchOS, it's an improvement from what we saw on Fitbit 2.0.

For fitness monitoring, the Versa Lite features an accelerometer, a heart rate monitor, an ambient light sensor, and an SPO2 sensor (which estimates changes in blood oxygen levels, helping to detect health issues such as sleep apnea). The watch tracks activity, heart rate, sleep, and female health. The dashboard shows all your metrics arranged in tiles, including steps, heart rate, exercise, sleep, weight, badges, and more. You can customize which tiles appear on your screen.

Unlike the standard Versa, the Versa Lite doesn't include an altimeter to track floors climbed or a gyroscope for counting laps in the pool (although it does have 5ATM water resistance, so you can wear it in the pool and in the shower). The Lite also doesn't include the Fitbit Coach app for on-screen workouts, and it doesn't support onboard music storage, though you can use it control whatever you're listening to on your phone). There's also no Wi-Fi, which isn't a big deal. And it lacks NFC for Fitbit Pay, which is available only on the \$230 Versa Special Edition.



This affordable entry-level smartwatch that provides everything beginners need to start monitoring their health and improving their fitness routines.



The Versa Lite packs the same 145mAh battery as the original, which Fitbit says should last up to four days.



In terms of battery, the Lite packs the same 145mAh battery as the original, which Fitbit says should last up to four days. In testing, I drained the battery much faster than that, but I also put it through significantly more use than most people would over the course of an average week, using battery-draining features far more than normal. No matter how much you use it, you definitely won't have to worry about placing it on the charger every night, which is more than you can say for the Apple Watch.

ACCURACY

During a one-mile walk, the Lite logged 2,483 steps to a 3D TriSport pedometer's 2,845, for a difference of 362 steps. Results for a one-mile run were even more accurate: The Versa logged 1,741 steps to the pedometer's 1,830, for a difference of just 89 steps.

In addition to the pedometer, I used a Stryd foot pod to test distance tracking. During a one-mile walk, the Versa logged one mile in comparison with the pedometer's 1.16 miles and the Stryd's 1.23. When the Versa hit one mile during my run, the pedometer logged 0.75 miles while the Stryd logged 0.71 miles. As with the original Versa, the Lite doesn't have GPS, which can explain why it's a little off. To help combat discrepancies, you can connect it to your phone to use its GPS radio.

As for heart rate monitoring, the Versa Lite is accurate compared with a Polar H10 chest strap. For the majority of my tests, it was only off by about one to four beats per minute to the chest strap.



Sleep tracking results were mixed. The Versa Lite had no problem identifying when I went to bed, when I woke up, and my sleep quality in between—but only when I slept through the entire night. Two mornings in a row, the Versa Lite tracked only a couple of hours of sleep. I realized it was because both nights I woke up to grab a drink of water or go to the bathroom. Even though the Versa recognized that I woke up, it didn't resume tracking my sleep after I went back to bed. Fitbit says this a known issue that the company is currently working to fix.

Content looks crisp and bright on the 1.34-inch squarish LCD display.

COMPARISONS AND CONCLUSIONS

Every other smartwatch we like costs more than the Versa Lite. The \$200 Samsung Galaxy Active tracks activity, sleep, and heart rate in a more stylish design,

but it has far shorter battery life. The \$255 Fossil Sport offers more in the way of apps, but it monitors only basic activity. The Apple Watch Series 4 is our favorite smartwatch all around, with the most features and apps, but it also costs more than twice the price of the Versa Lite, and of course, it works only with iPhones.

Unless you're a real fitness buff, the Versa Lite is perfectly capable of providing you with all the information you need to track everyday health and fitness. Is it worth saving \$40 over the standard Versa? That depends what you're looking for. A swimmer will want the Versa, since the Lite can't track laps. And if you like to work out with music without needing your phone nearby, you'll also want the original Versa for its onboard music storage. Ultimately, the Versa remains our Editors' Choice because it has something for everyone. But if you understand exactly what you want and what you're getting, the Versa Lite could be a better value for you.

BRENDA STOLYAR





Sonos One
(Gen 2)

\$199.99



Sonos One (Gen 2): Sound Quality Plus Alexa



Amazon's Alexa was once available only on Echo devices, and Google Assistant was limited to certain Android phones, but the popular voice assistants are everywhere now. The Sonos One has Alexa built in and will also have Google Assistant in the future. This wireless smart speaker is effectively the same as the \$149 Sonos Play:1 with the added benefit of a microphone array that lets you use Alexa just as though it were an Echo. Google Assistant was supposed to be added in 2018, but the update has been pushed back to sometime this year. Even with this delay, the speaker still sounds excellent and earns our Editors' Choice for its performance and versatility.

SONOS ONE GEN 1 VS. GEN 2

Sonos has recently updated the One with a faster processor and more memory, as well as Bluetooth Low Energy (BLE) support. BLE is only used as an option for setting up the speaker, and Bluetooth audio streaming is not present on this new model, which the company is calling the Sonos One Gen 2.

According to Sonos, the new processor and additional memory do not currently represent any new features or noticeable performance changes between the Gen 2 and the original model, which is now called the Sonos One Gen 1. But these upgrades can enable new features specific to the updated speaker in the future.

The Sonos One Gen 1 is still available from Sonos alongside the Gen 2 version, at a discounted price of \$179. This review is based on testing performed on the original Sonos One; we expect identical performance from the revised version.

DESIGN

At a glance, the One could be easily mistaken for the Play:1. It shares the same coffee can-like design, measuring 6.3 by 4.7 by 4.7 inches (HWD) in a squarish near-cylinder. The speaker is available in black or white, with a grille that runs almost the entire way around its sides. The top is a smooth, solid cap that adds almost an inch of height past the grille. The sides of the grille stop on the back, leaving room for a wide, solid strip that holds an Ethernet port and setup button. The power connector plugs into the bottom, in a recess with a channel that lets the cable run out of the back, under the Ethernet port.

Sonos One (Gen 2)

PROS Multi-room audio with flexible stereo and surround configurations. Powerful sound for its size. Works with Alexa voice control (with support for Google Assistant to come).

CONS Sound can distort at top volumes. No Bluetooth or wired audio connections.



While the One shares a similar profile with the Play:1, its physical controls are completely different. Instead of a contoured top panel with mechanical buttons for playback and volume, the One uses a completely flat top panel with touch-sensitive controls. A play/pause icon sits in the middle, flanked by two four-dot icons on either side. These icons are the One's touch controls, letting you play/pause and adjust volume by tapping and skip tracks by swiping. An indicator light sits above the play/pause icon, with a smaller microphone status light above that. A microphone icon above lets you mute the mic when you don't want a voice assistant listening in.

MULTI-ROOM AUDIO

Like all other Sonos speakers, the One supports multi-room, whole-home music playback through the Sonos app. While Sonos doesn't use an open system such as Google Cast, the company has built the most robust and broadly supported proprietary multi-room music platform on the market.

The Sonos app works with more than 50 different streaming music services, including Amazon Music, Apple Music, Google Play Music, Pandora, SiriusXM, and Spotify. You can also play music locally stored on your smartphone, tablet, or computer (Sonos Controller software is available on Android, iOS, Mac, and PC). That wide support should cover all of your music needs, which helps take the sting out of the One's lack of Bluetooth or any wired audio connections.

Sonos' multi-room system also supports setting up multiple Sonos speakers in the same room, and you can even pair two Ones together as a stereo set. You can also connect two One speakers with a Sonos Playbar or Playbase to serve as surround sound satellites, just like the Play:1.



Like other Sonos speakers, the One supports multi-room, whole-home music playback through the Sonos app.





ALEXA VOICE CONTROL

The One's biggest change over the Play:1, and its key selling point compared with other Sonos speakers, is support for voice assistants. You can connect the One to your Amazon account and use the Alexa voice assistant, letting you treat it like an Amazon Echo. Hands-free voice control lets you ask the One to play music or perform any supported Alexa task just by saying "Alexa."

For music, this means easy voice-controlled access to Amazon Music Unlimited and Prime Music, if you subscribe to either service. You can also tell Alexa to tune into almost any streaming internet radio station through TuneIn and iHeartRadio. Spotify access through Alexa is set to be added but was not enabled when we tested the speaker.

Alexa's informative voice assistant features are also available on the Sonos One. You can ask simple questions about weather, sports, news, general facts, and unit conversions, and the speaker will provide the answer. Third-party Alexa skills are also available, just like on an Echo device, so you can set up anything from language translation to ordering pizza. These skills need to be enabled through the Alexa app, not the speaker itself, but once they're loaded you're good to go.

If you have smart home devices that are compatible with Alexa, you can use the Sonos One to control them with your voice. I was able to turn on, turn off, and dim a Philips Hue White Ambiance bulb with relative ease. Setting these devices up to work with Alexa requires some digging and registration for individual services through the Alexa app, and the process can vary between different smart home systems, but it's the same set of steps you have to go through with any speaker in Amazon's Echo lineup.

As mentioned earlier, the Sonos One launched with Alexa support, but support for Google Assistant has been postponed to this year. When it's launched, the update should give it the same capabilities as a Google Home speaker and let you choose between using Alexa or Google Assistant for voice commands.

AUDIO PERFORMANCE

The One can get pretty loud for its size, but you shouldn't expect powerful low-end sound to come out of its small frame. It easily outshines comparably priced voice-assistant speakers such as the Amazon Echo and Google Home and stands on its own against its predecessor, the Play:1. Slightly larger speakers can get louder, and some, such as the JLab Block Party, even support multi-room playback, but those alternatives lack any voice-assistant support.

The speaker struggles with our bass test track, The Knife's "Silent Shout." At top volumes, the bass synth notes and kick drum hits distort slightly, causing crunchiness in the ideally flat, consistent sounds. This is similar to what we heard with the Play:1, and you can get around it by dialing the volume dial slightly. To the One's credit, it produces some appreciable sub-bass rumble.

"Roundabout" by Yes sounds excellent on the Sonos One, showing off the speaker's sound signature. The low-mids and highs are boosted, which gives the electric bass a good amount of punch and presence and lets the texture of the guitar strings really come through. Vocals stand cleanly in the front of the mix, ensuring that every aspect of the dense track gets some of your attention. The high-mids and highs are pushed up perhaps a bit overzealously, which adds some life to the guitar plinks but pushes the lower frequencies just slightly further back than they should be.



Speaking of dense mixes and strong high-frequency response, KMFDM's "Ultra" sounds properly energetic on the One. The guitar shredding gets most of the prominence, but the cacophonous industrial bassline stays present, and the hissed and growled vocals come through clearly.

Erasure's "Chains of Love" is represented extremely well here. The drums get plenty of presence, with a good amount of poppy thump typical of an 80s backbeat. The synths and vocals are clear and clean, standing out in the mix without overpowering the drums, letting all of the track's elements come together in ideally mixed synthpop bliss.

CONCLUSION

The Sonos One is a worthy and superior upgrade to the Play:1. It has all of the Play:1's excellent features and sound performance with the added benefit of Alexa and the promise of Google Assistant in the future. And it's head-and-shoulders above other voice assistant speakers in this price range, including the Amazon Echo and Google Home. The Marshall Stanmore II Voice and Google Home Max are both larger and more powerful Google Assistant-equipped speakers, but they're each about twice the price of the Sonos One. The Sonos Beam, meanwhile, offers the same Sonos streaming support and Alexa voice assistant in a soundbar form factor. In the \$200 range, however, the Sonos One is easily the best and most versatile voice assistant speaker available, and it's our Editors' Choice.

WILL GREENWALD



The Sonos One is head and shoulders above other voice assistant speakers in this price range, including the Amazon Echo.





HP Spectre x360 13 (2019): An Excellent 2-in-1

The HP Spectre x360 13 is the sort of 2-in-1 convertible laptop that turns the heads of people accustomed to the idea that premium laptops should be slabs of silver aluminum. If you cart yours around a major city blanketed with Apple laptops, as I did over a few days of testing, some of those folks will inevitably gasp, “Wow, what is that?” Perhaps the most remarkable thing is that it’s not really new. The 2019 iteration is simply an ingenious update to an excellent design that’s been around for a few years. There’s one significant oversight—a clumsy touchpad—but the Spectre x360 13 unquestionably keeps its place among the best premium, compact 2-in-1s you can buy.

**HP Spectre
x360 13
(2019)**

\$1349.00



WHAT'S CHANGED?

The Spectre x360 is available in either 13-inch or 15-inch variants. Both have 360-degree hinges that let you convert them into tablets, but the 13-inch subject of this review is the best choice for people who want to perform that conversion frequently. A 15-inch convertible is simply too unwieldy for frequent tablet use, though it's fine for propping up as a tent or an easel for watching videos.

The 13-inch version is far easier to grip with one hand without getting a cramp. But it's actually slightly thicker and heavier than last year's Spectre x360 13 model, which stands 0.53 inch thick and weighs 2.85 pounds. Those are aggressively thin and light dimensions for a convertible laptop, which must pack extra strength and hardware into the frame to enable a functional 360-degree hinge. In fact, HP realized that it would have to back off a bit if it wanted to add better-performing components and a longer-lasting battery to the new model.

HP Spectre x360 13 (2019)

PROS Corner-mounted power button and USB port. Excellent battery life. Sleek design.

CONS Cumbersome touchpad. Bottom of laptop gets very warm.

With head-turning looks, long battery life, and innovative port placement, the HP Spectre x360 13 is an excellent 2-in-1 convertible laptop.



That's exactly what the company did. The new Spectre x360 13 is 0.57 inches thick and weighs 2.9 pounds—small-enough increases that you'd be hard-pressed to tell the difference but enough to advertise a 17 percent performance improvement and 21 percent longer battery life. Spoiler alert: The precise percentages might vary, but this is one of the most powerful, longest-lasting ultraportables we've tested.

In addition to making room for better-performing internal components, HP also reconfigured some parts of the laptop's exterior design. The most significant change is on the back corners of the chassis, which now include a power button (on the left corner) and a USB Type-C port (on the right corner).

It's a unique approach to solving a frustrating problem: If you go with a traditionally placed power button in the keyboard, turning off the device or putting it to sleep when you're using it as a tablet is hard, since the power button is located underneath. On the other hand, if you place the power button on the left or right edge, as HP and other manufacturers have done on past 2-in-1s, it's too easy to accidentally press when you're gripping the laptop to unplug a peripheral. A corner-mounted button solves this problem while still making it accessible when the laptop is folded into a tablet.



The precise percentages might vary, but this is one of the most powerful, longest-lasting ultraportables we've tested.



Speaking of plugging in peripherals, one of the main problems with doing so is that the cord will almost always stick out of the left or right edges where the ports reside, cluttering up your desk at best and impeding external mouse movements at worst. Ports typically can't be relegated to the back edge, because the hinge needs that space to enable the 360-degree rotation that converts the machine into a tablet. Placing the plug in the corner solves both problems. It won't stick out and block your mouse movements, nor will it impede rotation. Even better, because the Spectre x360 13 uses a USB Type-C charging cable, the corner-mounted port is the only one you'll need to use in many cases.

Finally, HP has also moved the fingerprint reader from the right edge, where it lives on last year's model, to a more conventional placement next to the keyboard. This puzzled me, since a keyboard-mounted fingerprint reader is hard to access in Tablet mode, but HP says customer feedback shows that people prefer it this way. Perhaps I'm in the minority in preferring an edge-mounted reader.

A SPECTRE FROM THE PAST: WHAT'S THE SAME?

Aside from the slight rejiggering of weight, height, ports, readers, and buttons, much about the Spectre x360 13's physical design remains the same. That's a good thing.




With its angular, faceted edges, this laptop isn't exactly sleek, but it still looks gorgeous. The unit I tested is clad in Dark Ash Silver with Copper Luxe accents, and the overall effect is exactly that: This is a luxe laptop. You can also have a Spectre x360 13 in Poseidon Blue with Pale Brass accents. You'll get the faceted edges and corners with either color choice, of course, which gives it a vague resemblance to a precious gemstone and completes the upscale look.


Overall, I find the Spectre x360 13 infinitely more attractive than mainstream 2-in-1s such as the Dell Inspiron 13 7000. I even prefer its looks to those of the Apple MacBook Pro, the Dell XPS 13 2-in-1, and the Lenovo Yoga C930, some of its main competitors in the premium ultraportable space. These machines are lookers in their own right, of course, but they lack the faceted edges that make the Spectre x360 13 unique.

A few privacy and security features help the Spectre x360 13 further stand out from the crowd. It offers an optional screen that includes an integrated privacy filter called SureView. You can turn it on at the touch of the F1 key, which will instantly reduce the screen's off-center viewing angle to prevent snoopers from looking over your shoulder. (I didn't test the SureView-equipped version.)

There's also a physical kill switch for the webcam to prevent online hackers from snooping. Other manufacturers, especially Lenovo, have experimented with physical sliders that cover the webcam lens, but those don't work well with the IR sensors next to the Spectre x360 13's webcam, which let you log in to Windows 10 using face recognition. The kill switch, located on the left edge, disconnects the power to the webcam but not the microphone.



With its angular, faceted edges, this laptop isn't exactly sleek, but it still looks gorgeous.





The backlit keys have sturdy switches, and they depress with a satisfying thud instead of a wimpy clicking noise. The only problem with the keyboard is its half-height up- and down-arrow keys. I far prefer the full-height ones that you'll find on some Dell and Lenovo business laptops.

I tested the full HD (1,920-by-1,080-pixel) touch-display option, which offers average picture quality for a glossy display. That is to say, reflections from ambient light can get in the way of what's on screen, even when the brightness is turned all the way up. And colors are vivid and text sharp, though not as vivid or sharp as they would be on a 4K display. Such a display is an option on the Spectre x360 13 and would be an excellent choice if you want something that approximates the MacBook Pro's excellent Retina Display. Be warned, though, that the higher-resolution 4K will likely consume more power and shorten battery life.

To use the touch screen, you can either tap on it with your finger, or draw or write on it with HP's active digital stylus, included in the configuration I reviewed. Tapping and writing in Laptop or Stand mode isn't easy due to the significant screen bounce. But the screen is very good at rejecting inputs from your palm when you rest it on the screen to draw or write, which makes for a very satisfying experience in Tablet mode.

The audio quality and typing experience on the Spectre x360 13 are very good, though we expect no less from a premium laptop. The body has four speakers and a discrete amplifier, which results in loud—if not particularly robust—audio. The backlit keys have sturdy switches, and they depress with a satisfying thud instead of a wimpy clicking noise. The only problem with the keyboard is its half-height up- and down-arrow keys. I far prefer the full-height ones that you'll find on some Dell and Lenovo business laptops, though half-height ones are sadly common. The XPS 13 and MacBook Pro use them, too.



The x360 13's touchpad is far too twitchy out of the box, making accurate cursor movements all but impossible.

Alas, the Spectre x360 13's touchpad is subpar. It's far too twitchy out of the box, making accurate cursor movements all but impossible. After the "Wow, what is that?" question, the next thing to come out of most people's mouths when I let them play with the Spectre x360 13 was, "Um, what's up with the touchpad?"

Worse, because HP uses Synaptics' touchpad software instead of the more user-friendly Windows Precision Touchpad interface, there are plenty of esoteric adjustments, including SmartSense, Momentum, and EdgeMotion, but no simple speed or sensitivity settings. (You have to go to the Windows 10 Mouse item in Control Panel for that.) In the end, I spent a lot of time fiddling with settings in multiple dialog boxes and never got the touchpad to work to my satisfaction.

In addition to the USB Type-C port in the right corner, there's a second USB Type-C port on the right edge. Both of these support Thunderbolt 3 connections of up to 40GBps. A USB 3.1 Gen 2 Type-A port, a microSD card slot, and an audio input/output port round out the I/O selection. That's a generous array, especially when you consider that some of the Spectre x360 13's competitors lack Thunderbolt 3, USB Type-A, or both.

Wireless connections include standard Bluetooth 5.0 and 802.11ac Wi-Fi. A gigabit LTE modem with dual SIM support is an optional extra.

EXCELLENT COMPUTING PERFORMANCE

The HP Spectre x360 13 shares many components with its similarly priced competitors, as you can see in the chart below. The main differences in core components have to do with the CPU's generation. The HP's Core i7-8565U, which is also found in the LG Gram 14 2-in-1 and the Dell Inspiron 13 7000 2-in-1, is from Intel's latest ("Whiskey Lake") mobile CPU family. Meanwhile, the Lenovo ThinkPad X380 and the Apple MacBook Pro include similar Core i5 chips from the older "Kaby Lake" generation.

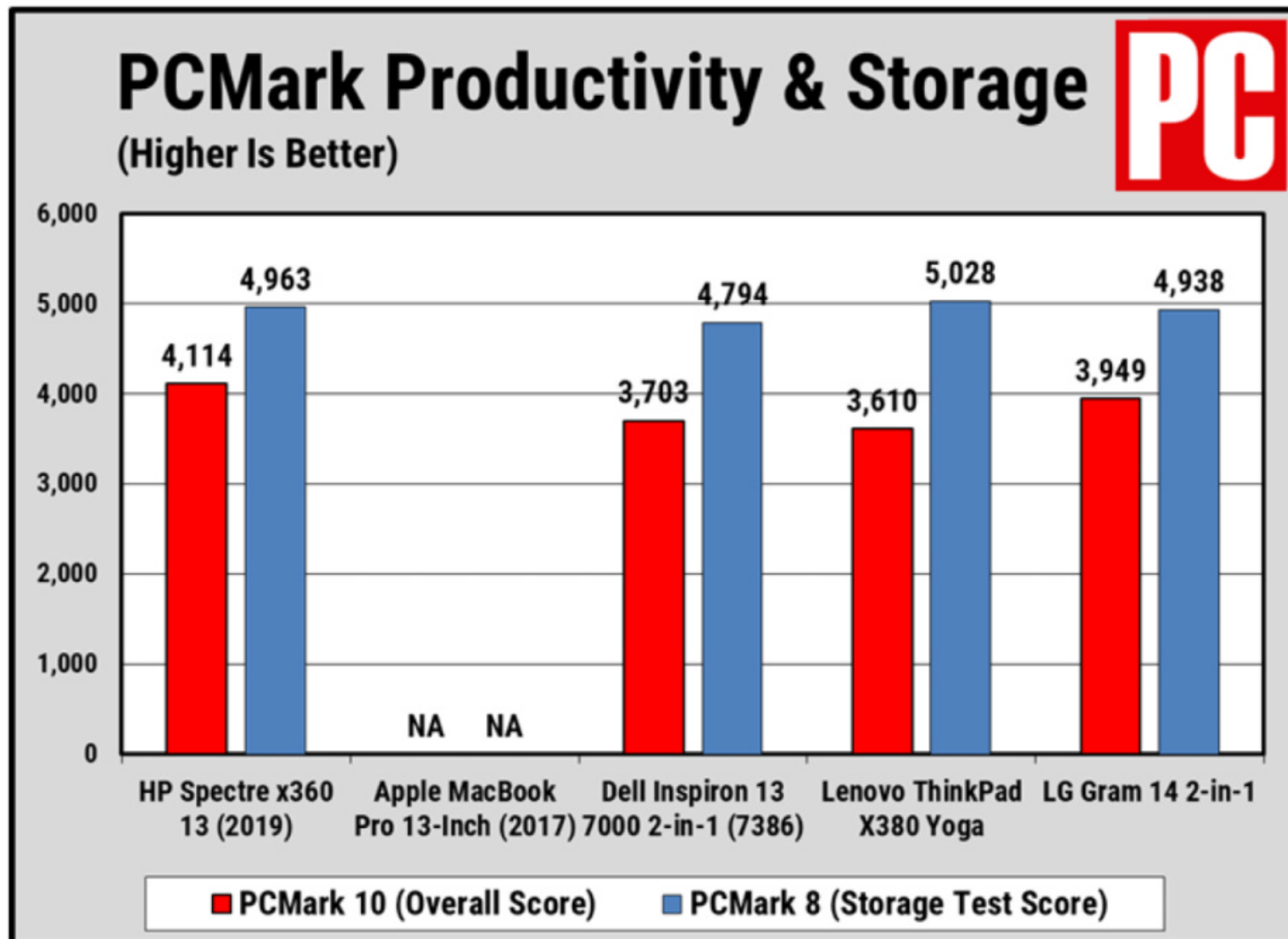
| Test System Configurations | | | PC |
|-------------------------------------|------------------------------|------------------------------|---------------------|
| | PROCESSOR | GRAPHICS | MEMORY & STORAGE |
| HP Spectre x360 13 (2019) | Intel Core i7-8565U (1.8GHz) | Intel UHD Graphics 620 | 8GB RAM; 256GB SSD |
| Apple MacBook Pro 13-Inch (2017) | Intel Core i5-7360U (2.3GHz) | Intel Iris Plus Graphics 650 | 8GB RAM; 128GB SSD |
| Dell Inspiron 13 7000 2-in-1 (7386) | Intel Core i7-8565U (1.8GHz) | Intel UHD Graphics 620 | 8GB RAM; 256GB SSD |
| Lenovo ThinkPad X380 Yoga | Intel Core i5-8250U (1.6GHz) | Intel UHD Graphics 620 | 8GB RAM; 512GB SSD |
| LG Gram 14 2-in-1 | Intel Core i7-8565U (1.8GHz) | Intel UHD Graphics 620 | 16GB RAM; 512GB SSD |

Noticeably absent from this comparison is the Lenovo Yoga C930 and Dell XPS 13 2-in-1. We haven't tested either of these machines with our latest benchmark process (which we renewed late last year), so they're represented by the ThinkPad and Inspiron stand-ins.

PRODUCTIVITY TESTS

The first tests in our benchmark regimen are holistic performance suites developed by the PC benchmark specialists at UL (formerly Futuremark). The PCMark 10 test we run simulates different real-world productivity and content-creation workflows. We use it to assess overall system performance for office-centric tasks such as word processing, spreadsheeting, web browsing, and video conferencing. The test generates a proprietary numeric score; higher numbers are better.

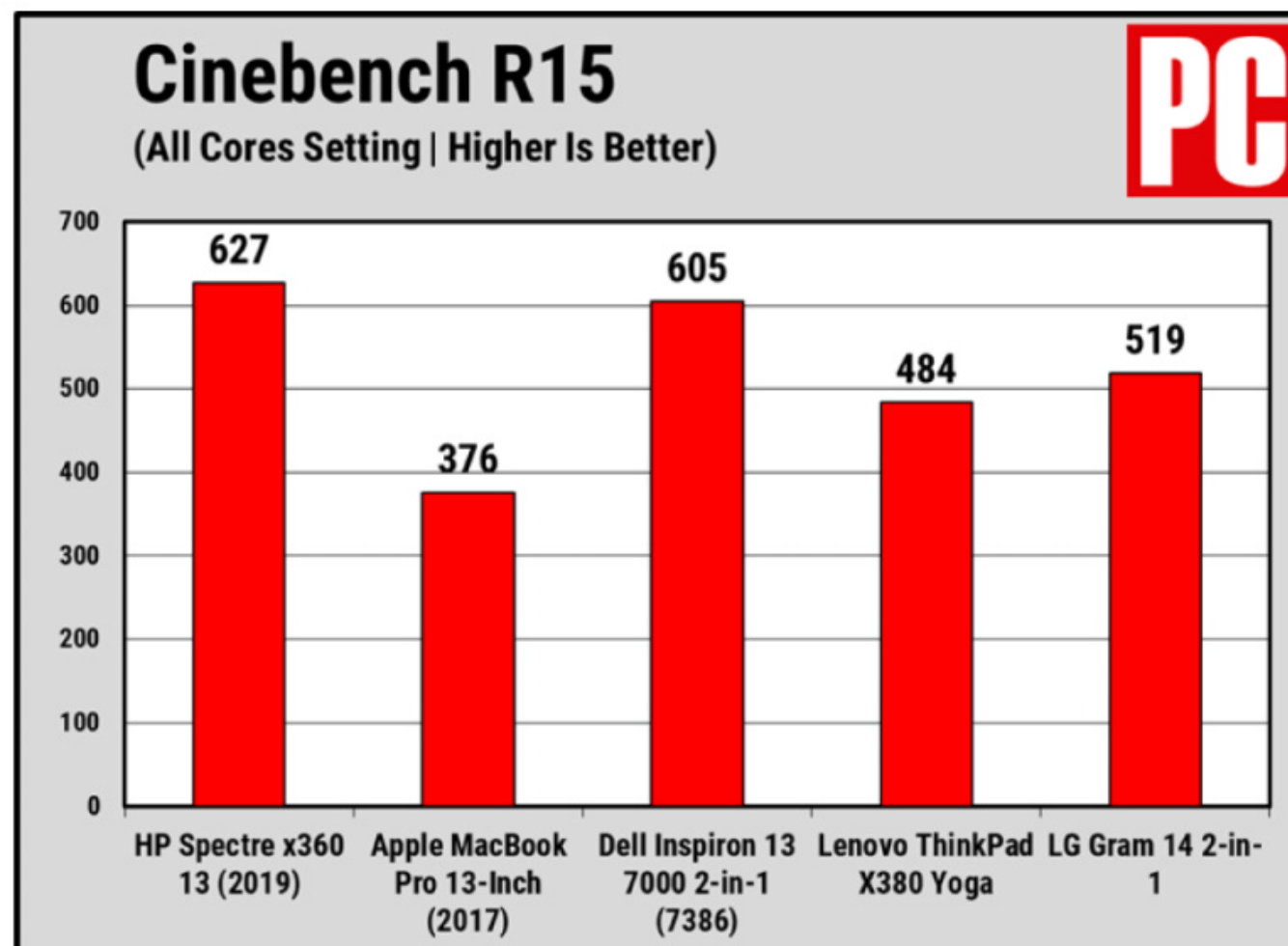
PCMark 8, meanwhile, has a Storage subtest that we use to assess the speed of the storage subsystem. This score is also a proprietary numeric score; again, higher numbers are better. (Neither PCMark benchmark is compatible with macOS.)



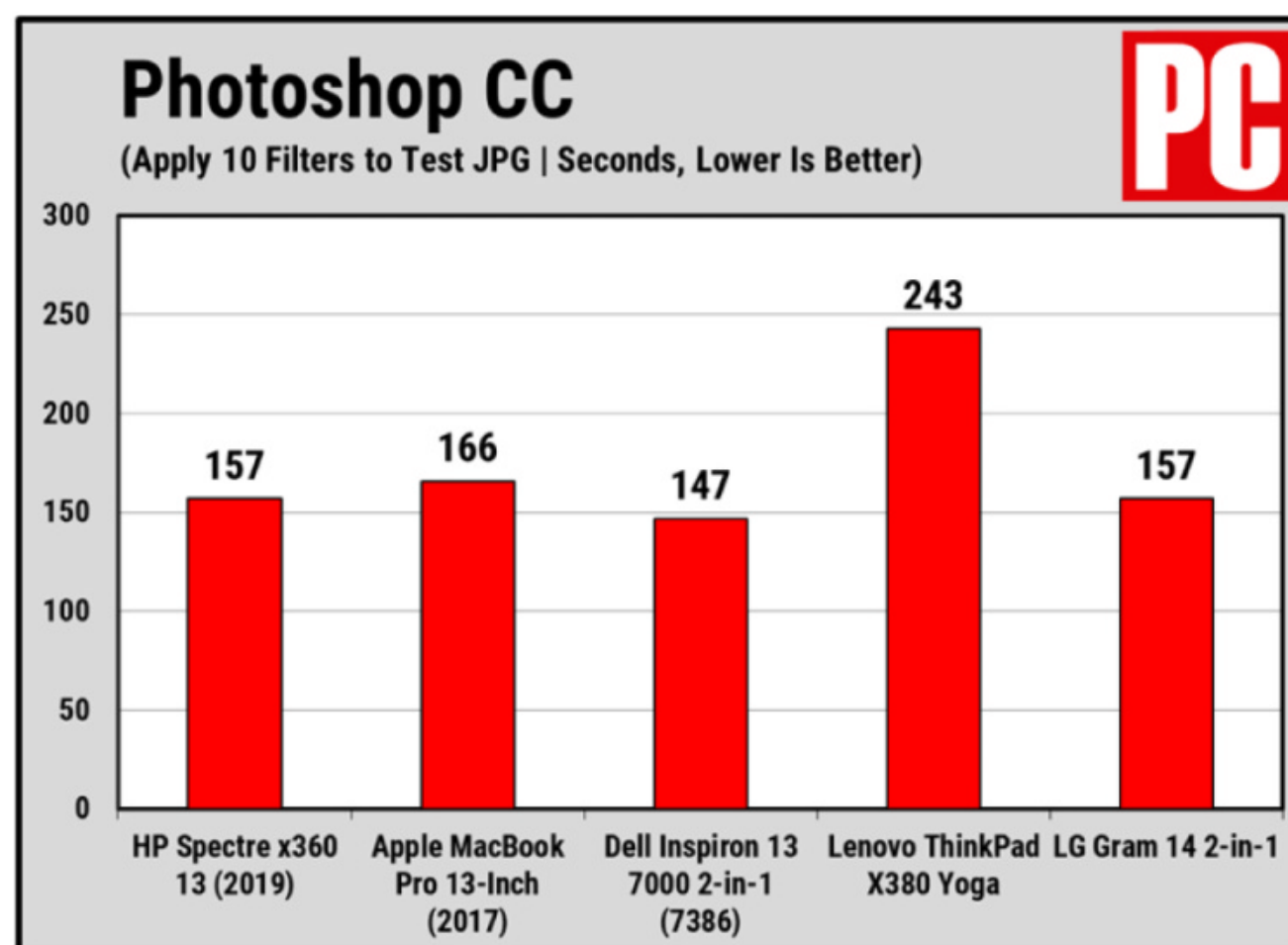
Thanks to the similar SSDs and CPUs in these machines, they all perform within a few hundred points of one another.

Thanks to the similar SSDs and CPUs in each of these machines, they all perform within a few hundred points of one another on these tests, as expected. Still, the Spectre x360 13 deserves congratulations for leading the pack on the all-important PCMark 10 test. Its performance was not without a struggle, though: The bottom of the laptop grew rather warm to the touch, though not warmer than I've encountered with the Apple MacBook Pro.

It also took first place in Maxon's CPU-crunching Cinebench R15 test, which is fully threaded to make use of all available processor cores and threads. Cinebench stresses the CPU rather than the GPU to render a complex image. The result is a proprietary score indicating a PC's suitability for processor-intensive workloads.



We also run a custom Adobe Photoshop image-editing benchmark. Using an early 2018 release of the Creative Cloud version of Photoshop, we apply a series of 10 complex filters and effects to a standard JPEG test image. We time each operation and, at the end, add up the total execution time. As with Handbrake, lower times are better here. The Photoshop test stresses CPU, storage subsystem, and RAM, but it can also take advantage of most GPUs to speed up the process of applying filters, so systems with powerful graphics chips or cards may see a boost.

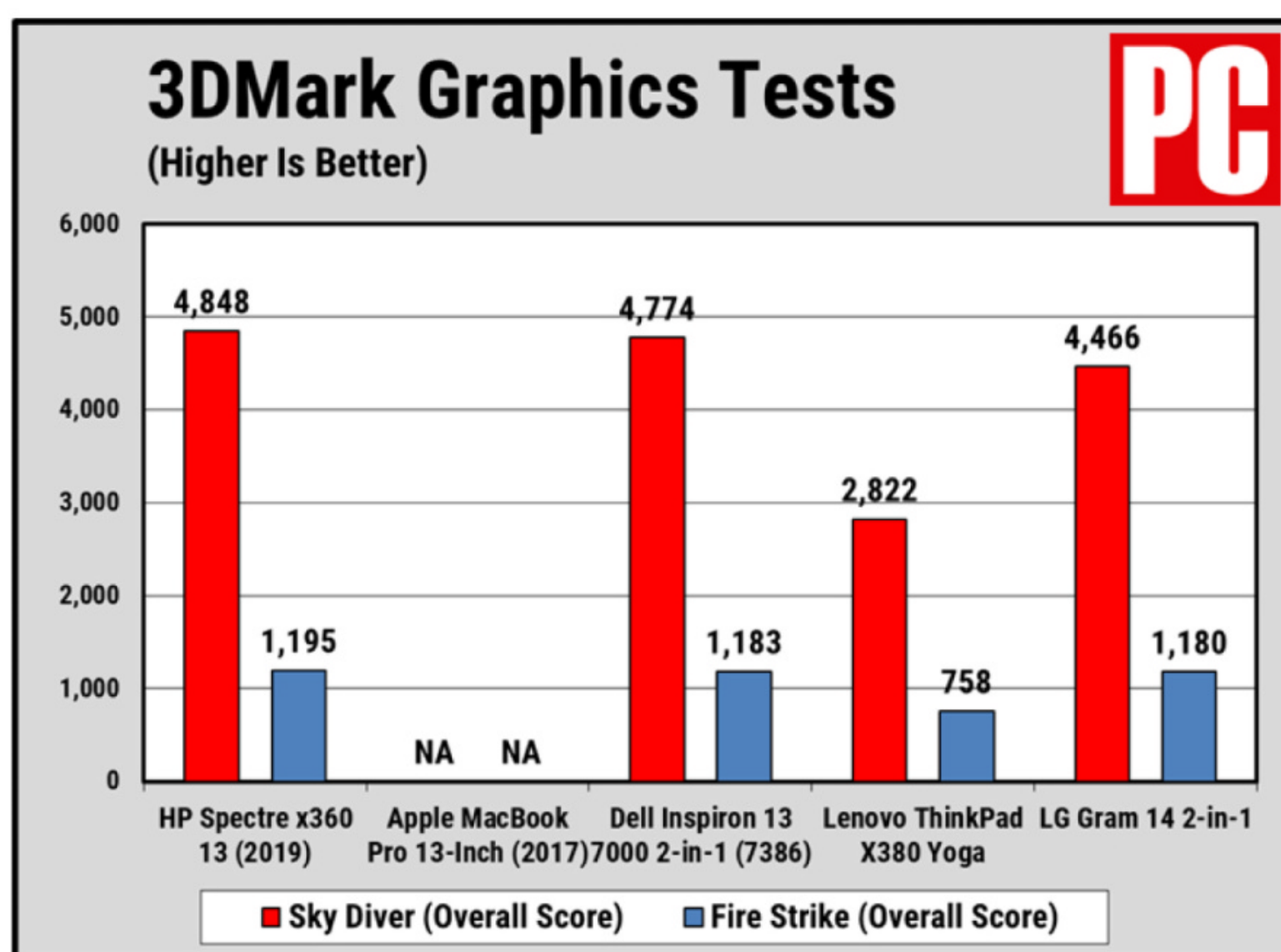


None of these laptops has powerful graphics processors, though, since they're not large enough to accommodate the cooling hardware required for a discrete GPU. So they all finished within a few seconds of each other, with the exception of the much slower ThinkPad X380.

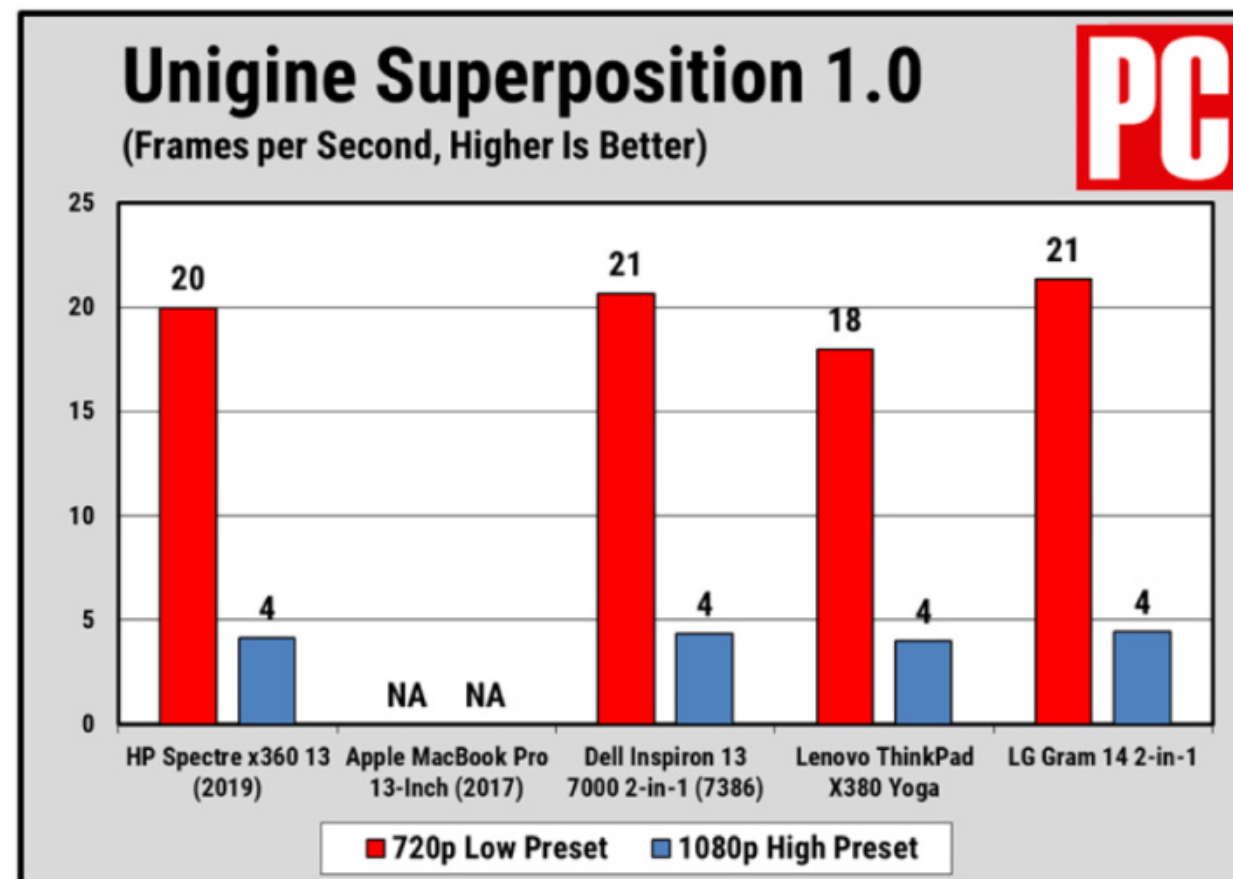
GRAPHICS TESTS

Since there are no discrete GPUs among the lot, the Spectre x360 13 and its competitors also offer roughly equal performance on our graphics benchmarks like 3DMark, which measures relative graphics muscle by rendering sequences of highly detailed, gaming-style 3D graphics that emphasize particles and lighting. We run two different 3DMark subtests, Sky Diver and Fire Strike, which are suited to different types of systems. Both are DirectX 11 benchmarks, but Sky Diver is more suited to laptops and midrange PCs, while Fire Strike is more demanding and made for high-end PCs to strut their stuff. The results are proprietary scores.

We run two different 3DMark subtests, Sky Diver and Fire Strike, which are suited to different types of systems.



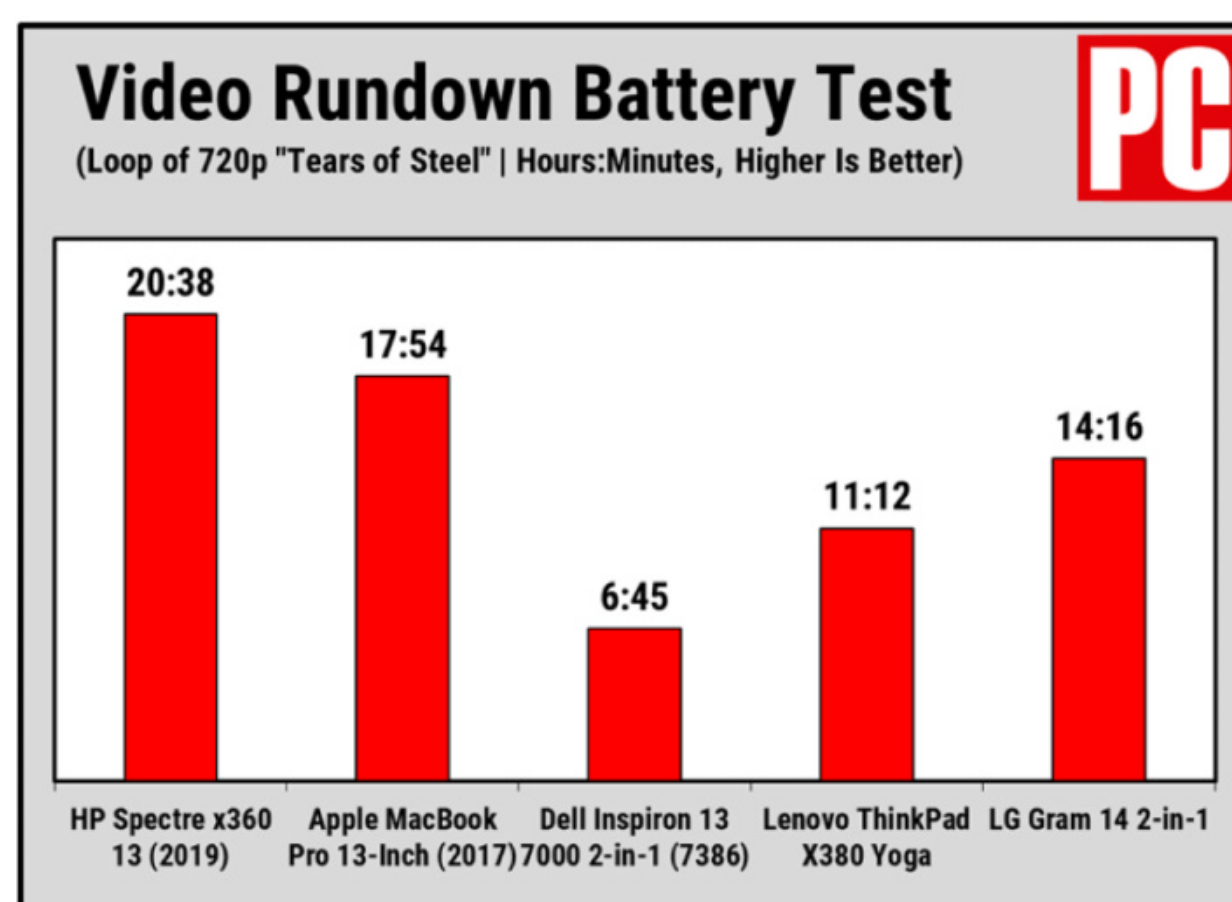
Next up is another synthetic graphics test, this time from Unigine Corp. Like 3DMark, the Superposition test renders and pans through a detailed 3D scene and measures how the system copes. In this case, it's done in the company's eponymous Unigine engine, offering a different 3D workload scenario than 3DMark, for a second opinion on the machine's graphical prowess. We present two Superposition results, run at the 720p Low and 1080p High presets. Neither 3DMark nor Superposition is compatible with macOS.



For lower-end systems, maintaining at least 30fps is the realistic target, while more powerful computers should ideally attain at least 60fps at the test resolution. Neither the Spectre x360 13 nor its competitors achieved these targets (normal for integrated-graphics-based models like these), which suggests that you'll need to limit your gaming to Minecraft, Candy Crush, and the like.

BATTERY TESTING

After fully recharging the laptop, we set up the machine in power-save mode (as opposed to balanced or high-performance mode) and make a few other battery-conserving tweaks in preparation for our unplugged video rundown test. (We also turn off Wi-Fi, putting the laptop in Airplane mode.) In this test, we loop a video—a locally stored 720p file of the open-source Blender short film Tears of Steel—with screen brightness set at 50 percent and volume at 100 percent until the system conks out.



This is where the Spectre x360 13 really shines. Lasting nearly 21 hours on this test is a brag-worthy achievement, but it doesn't tell the whole story, since few users will endlessly loop video. Luckily, chances are you won't be disappointed in real-world use. I had to plug in the Spectre x360 13 only once during a weekend of web browsing and video playing and using the PC for hours each day.

THIS SWIVELING SPECTRE SHINES

With class-leading performance, excellent battery life, and head-turning looks, there's very little to dislike about the Spectre x360 13. Were it not for the subpar touchpad, it would earn our Editors' Choice as the best high-end 2-in-1 laptop. As it stands, the Lenovo Yoga C930 is still our top pick, but if you find yourself more annoyed by accidental power-button presses and peripheral cords than cumbersome cursor movements, the Spectre x360 13 could be your best option.

TOM BRANT



I had to plug in the Spectre x360 13 only once during a weekend of web browsing and video playing for hours each day.



**Digital Storm
Lynx**

Starts at \$799;
\$1,999 as tested



Digital Storm Lynx: A Well-Crafted Gaming PC



Build it yourself, or go with a prebuilt model? That's the classic dilemma when you're shopping for a gaming desktop. California-based specialty builder Digital Storm aims to deliver the benefits of both worlds with its Lynx mid-tower. Designed for serious gaming, it's offered in four prebuilt configurations (named Levels 1 to 4) to meet most budgets, maxing out with eight-core Intel Core i7 or AMD Ryzen 7 CPUs and Nvidia GeForce RTX 20-class graphics cards. Other high-end options include liquid cooling and full LED case lighting. Spotless attention to detail, smart part selection, and superb overall performance (in our test model) make the Lynx an alluring choice for a gaming mid-tower at its value-packed price and an easy substitute for doing the DIY thing.

MAKING A CLEAR CASE FOR IT

The Lynx isn't an off-the-shelf, mass-produced desktop. While the chassis and certain internal components are designed or branded by Digital Storm, they're all standard parts that have aftermarket equivalents.

In fact, most of the parts inside are aftermarket to begin with, such as the motherboard and graphics card. I was able to locate most of them at online retailers. That's part of the allure of getting a prebuilt desktop from a system builder like Digital Storm; it's essentially a product of the aftermarket, but expertly assembled and covered by a system warranty, meaning you don't have to deal with individual part warranties. You have single-destination tech support you can call if you need help. And the Lynx is covered by a three-year labor, one-year parts warranty.

The Lynx has highly typical dimensions for an ATX mid-tower, at 18 by 7.9 by 18.4 inches (HWD). Most of the build is sturdy metal, while the front panel cover is plastic. The left-side panel is tinted, tempered glass. The right-side panel is metal.

Digital Storm Lynx

PROS Well-priced, given the parts inside. Great for fast-paced 1080p and 1440p gaming, as tested. Impeccable attention to detail. Remote-controlled LED bling system. Ample cooling.

CONS Could be quieter under load. No flash-card reader.





The look is aggressive without being gaudy. I'm grateful for the lack of polarizing curves and design cues. Multiple RGB-lit fans and LED light strips make the Lynx a real attention-getter; a handy remote is included for controlling the colors and patterns or turning off the show entirely.

At the top of the tower, the magnetically attached dust filter makes maintenance a breeze. Simply pull it off and vacuum or wash it as needed. The port selection along the front edge includes separate headphone and microphone jacks, and a pair of USB Type-A 3.0 ports.

There's also the power button, a reset button, and a drive activity light up here. A flash-card reader would have been nice, though; that's one of the few convenience features missing.

Four raised feet with rubber pads give the Lynx some breathing room from the underside, as well as keeping it from sliding around. There's another removable dust filter covering the power supply's air intake on the bottom of the tower.

Our Lynx review unit doesn't have wireless connectivity, but Wi-Fi is available as an option. On the back of the tower, the port selection will vary based on the components.

The Asus Prime Z390-P ATX motherboard in our tester has legacy PS/2 keyboard and mouse ports, two USB 3.1 Type-A ports, four USB 3.0 Type-A

ports, an Ethernet jack, and a trio of audio connections: microphone-in, line-out, and line-in. The aluminum backplate looks out of place, given the blacked-out theme.

The onboard HDMI and DisplayPort video-out connectors are disabled in lieu of the dedicated graphics card in this review unit, which is an Asus-brand GeForce RTX 2070. The card has an HDMI video-out connector, two DisplayPort video-out connectors, and a VirtualLink USB Type-C port for next-generation virtual-reality (VR) headsets. All Lynx configurations include dedicated graphics of some kind.



A LOOK AT THE INTERIOR

Accessing the Lynx's interior entails removing two thumbscrews that secure the tempered-glass side door. The spacious interior is expertly wired. Haphazardly tied-off cables are strictly prohibited in here. You won't see any unused cables, either; the top-shelf Corsair RMx Series RM750x 750-watt power supply in our unit is fully modular, so extraneous cables aren't even connected. Digital Storm includes them in the accessories box, if you need them later.

The Asus Prime Z390-P ATX motherboard in our review unit is a basic yet very capable Intel Z390-based model. It has four DIMM slots for memory, occupied here by two 8GB DDR4-3200 DIMMs (for 16GB total), wearing Digital Storm-branded heat spreaders. The motherboard's single M.2 Type-2280 (80mm) slot

holds an excellent-quality 500GB Samsung SSD 970 EVO PCI Express drive in our configuration. And the circular waterblock over the processor has RGB backlighting.

The Core i7-9700K processor in this unit can be overclocked via the motherboard's BIOS, but it doesn't come overclocked by default. (Digital Storm offers from-the-factory overclocking services for both the processor and graphics card, if you so desire.) The conventional look of the blower-style GeForce RTX 2070 graphics card melds well with the blacked-out case interior. It has a faint LED strip going diagonally through its center.

The lack of 3.5- or 5.25-inch bays along the front of the tower allows for uninterrupted front-to-back airflow. The 240mm liquid-cooling radiator for the processor is mounted vertically behind the front panel. Two 120mm fans send cool air through it, while a third 120mm fan mounted underneath provides cooling to the 3.5-inch drive bays.

In modern fashion, the power supply is isolated in its own partition along the bottom of the tower. Two 3.5-inch drive bays are located just in front of it. Those are the only 3.5-inch bays you get, which is limiting in a mid-tower as large as the Lynx. To access them, remove the two thumbscrews securing the right-side panel, and slide it back. One of the 3.5-inch bays is occupied by a 2TB Toshiba-brand hard drive in this test unit. Power and SATA connectors are pre-routed to the empty drive bay and its tool-less, slide-out caddy. That's a good thing, as I doubt I could wire them as concisely.

Indeed, the wiring speaks volumes about the Lynx. This kind of attention to detail generally isn't found in mainstream, mass-produced desktops.



The look is aggressive without being gaudy. I'm grateful for the lack of polarizing curves and design cues.





DIYers: The Digital Storm's Lynx will make you think twice about building your own gaming desktop. It's expertly crafted, with top-tier performance at the right price.

VALUE-PACKED PERFORMANCE

Our \$1,999 “Level 4” Lynx review unit is the most powerful configuration preset that Digital Storm offers in this chassis. It includes all the power you need for playing today's AAA titles at 1080p, 1440p, and even 4K resolutions. If you're gung-ho about 4K, consider upping your graphics-card choice to a GeForce RTX 2080, as the GeForce RTX 2070 in our unit is right on the edge of playability in some of today's games.

Prebuilt desktops usually command some premium for assembly, so to figure out what I could save if I built it myself, I part-shopped online for the included components to get a ballpark estimate. I was surprised that my mock-build arrived at nearly the same price as our Lynx review configuration. In other words, the premium is nominal.

Even if you were building it yourself, this kind of value proposition ought to make you reconsider. As I noted earlier, Digital Storm covers the Lynx with a system-wide warranty. When you DIY, you'll have warranties on the individual parts but not on the entire system, so you'll need to do your own troubleshooting. And I've pointed out the excellent wiring and assembly job; doing the same quality of work on your own takes more patience than you might think.

Checking out the competition, I found an Alienware Aurora mid-tower configuration on Dell's website for \$2,099 that had a similar loadout as our Lynx but with only half the hard drive space (1TB). Lenovo's Legion T730 mid-

tower was cheaper at \$1,799, but having reviewed that unit first-hand, I can say that it doesn't have the fit and finish, nor the aftermarket appeal, of the Lynx, and it isn't as well-cooled.

One big-box unit that does give the Lynx a run for its money is the HP Omen Obelisk; it's competitively priced, offering a more powerful GeForce RTX 2080 graphics card for less than our Lynx (at least at the time I wrote this), but it's a smaller tower without as much expansion capability.

PERFORMANCE TESTING

Our new testing regimen has been around long enough that I can pack the comparison charts full of competition for the Digital Storm Lynx. I compared it with these gaming desktops.

| Test System Configurations | | | PC |
|----------------------------------|------------------------------|-------------------------------|------------------------------|
| | PROCESSOR | GRAPHICS | MEMORY & STORAGE |
| Digital Storm Lynx | Intel Core i7-9700K (3.6GHz) | Nvidia GeForce RTX 2070 (8GB) | 16GB RAM; 500GB SSD, 2TB HDD |
| Corsair Vengeance Gaming PC 5180 | Intel Core i7-8700 (3.2GHz) | Nvidia GeForce RTX 2080 (8GB) | 16GB RAM; 480GB SSD, 2TB HDD |
| HP Omen Obelisk 875-00qd | Intel Core i7-8700 (3.2GHz) | Nvidia GeForce RTX 2080 (8GB) | 32GB RAM; 512GB SSD, 1TB HDD |
| Lenovo Legion T730 Tower | Intel Core i7-8700K (3.7GHz) | Nvidia GeForce GTX 1060 (6GB) | 16GB RAM; 128GB SSD, 1TB HDD |
| Origin PC Neuron | AMD Ryzen 7 2700X (3.7GHz) | Nvidia GeForce RTX 2080 (8GB) | 16GB RAM; 480GB SSD; 2TB HDD |

The Corsair, HP, and Origin machines use considerably faster (more expensive) GeForce RTX 2080 graphics cards, which should have no problems edging out the GeForce RTX 2070 in our Lynx. The Lenovo Legion T730 represents a good “minimum spec” for a 1080p

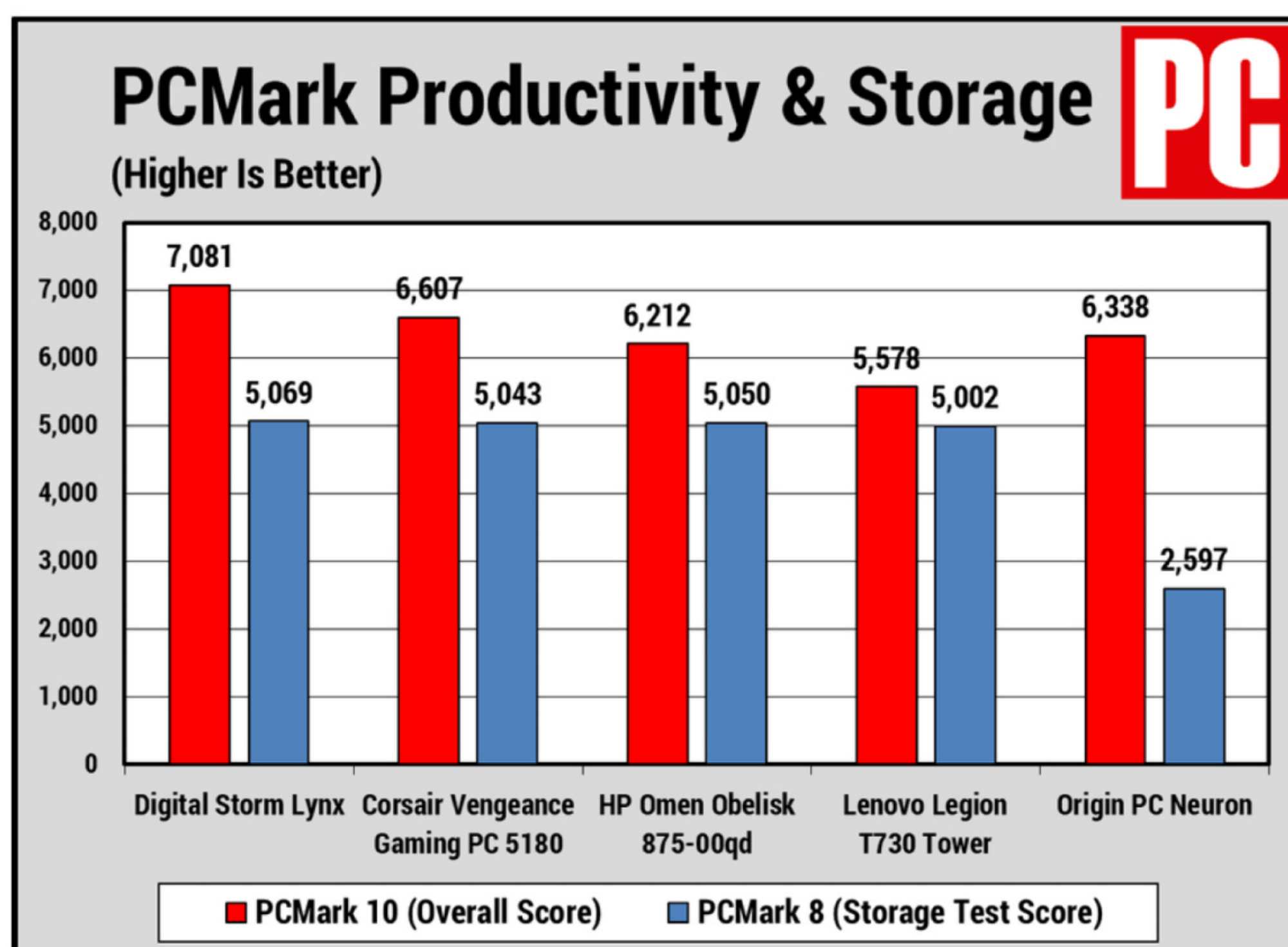
I was surprised that my mock-build arrived at nearly the same price as our Lynx review configuration.

and mild 1440p gaming rig; it's about half the price of the Lynx. The Origin PC Neuron (a review of that one is in progress) uses AMD's flagship Ryzen 7 2700X eight-core processor, which should be a good matchup to the Core i7-9700K in the Lynx.

PRODUCTIVITY AND STORAGE TESTS

PCMark 10 and 8 are holistic performance suites developed by the PC benchmark specialists at UL (formerly Futuremark). The PCMark 10 test we run simulates different real-world productivity and content-creation workflows. We use it to assess overall system performance for office-centric tasks such as word processing, spreadsheeting, Web browsing, and videoconferencing. The test generates a proprietary numeric score; higher numbers are better.

PCMark 8, meanwhile has a Storage subtest that we use to assess the speed of the drive subsystem. This score is also a proprietary numeric score; again, higher numbers are better.

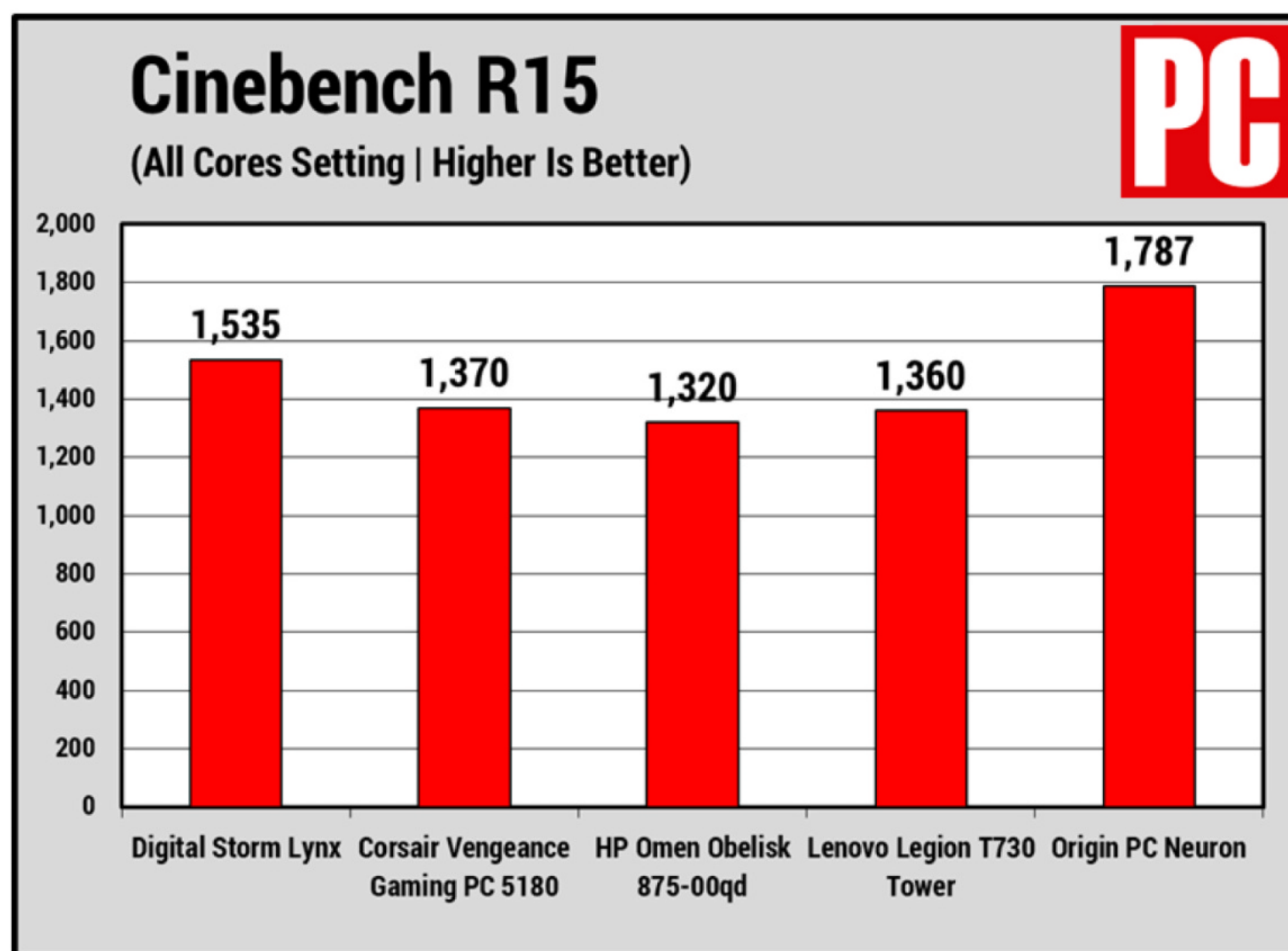


The Digital Storm Lynx serves up an outstanding 7,081-point showing in PCMark 10, which is one of the highest scores we've seen from a gaming desktop. For reference, the fastest gaming notebooks we've tested recently have

come in around 5,000 points. Given the PCMark 8 Storage test shows a relatively even playing field (the Origin PC Neuron being an anomalous exception), it stands to reason the Core i7-9700K processor, Intel Z390-based motherboard, and speedy DDR4-3200 memory helped propel our Lynx to the top.

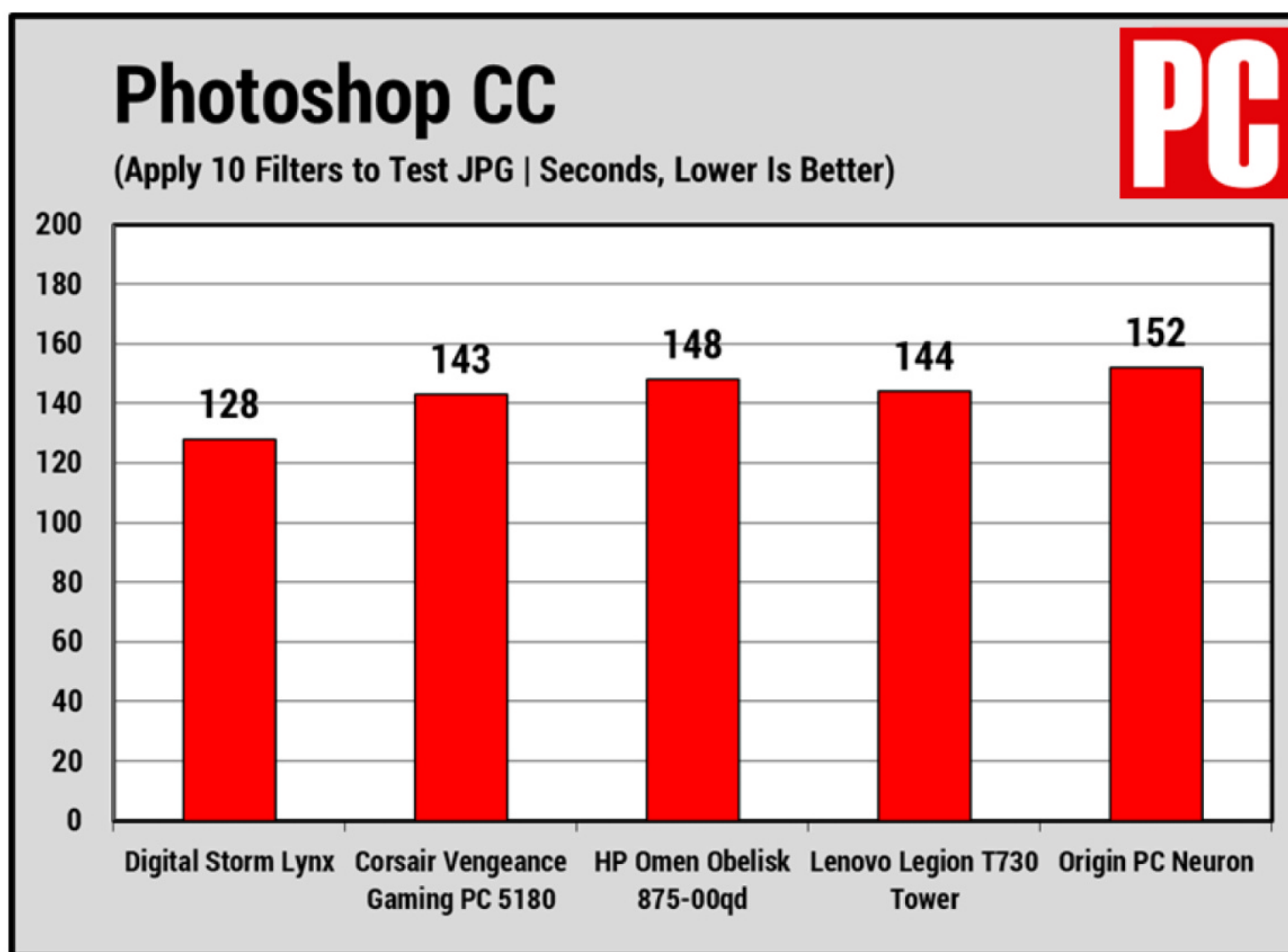
MEDIA PROCESSING AND CREATION TESTS

Next is Maxon's CPU-crunching Cinebench R15 test, which is fully threaded to make use of all available processor cores and threads. Cinebench stresses the CPU rather than the GPU to render a complex image. The result is a proprietary score indicating a PC's suitability for processor-intensive workloads.



We also run a custom Adobe Photoshop image-editing benchmark. Using an early 2018 release of the Creative Cloud version of Photoshop, we apply a series of 10 complex filters and effects to a standard JPEG test image. We time each operation and, at the end, add up

the total execution time. As with Handbrake, lower times are better here. The Photoshop test stresses CPU, storage subsystem, and RAM, but it can also take advantage of most GPUs to speed up the process of applying filters, so systems with powerful graphics chips or cards may see a boost.



The Core i7-9700K processor in the Lynx has no trouble beating the older 8th Generation Core i7 six-core chips in the Corsair, HP, and Lenovo units in Cinebench, but it can't match the Origin's AMD Ryzen 7 2700X chip in raw power. That's largely because the Core i7-9700K can only process eight threads at once, whereas the Ryzen chip, despite also having eight cores, can simultaneously process 16 threads. (The Core i7-9700K doesn't support thread-doubling Hyper-Threading; Intel has gotten stingier with Hyper-Threading support in its 9th Generation mainstream chips, reserving it for the Core i9s.) Its advantages didn't spill over into the Photoshop test, where the higher clocks of the Core i7-9700K helped give the Lynx an undisputed advantage.

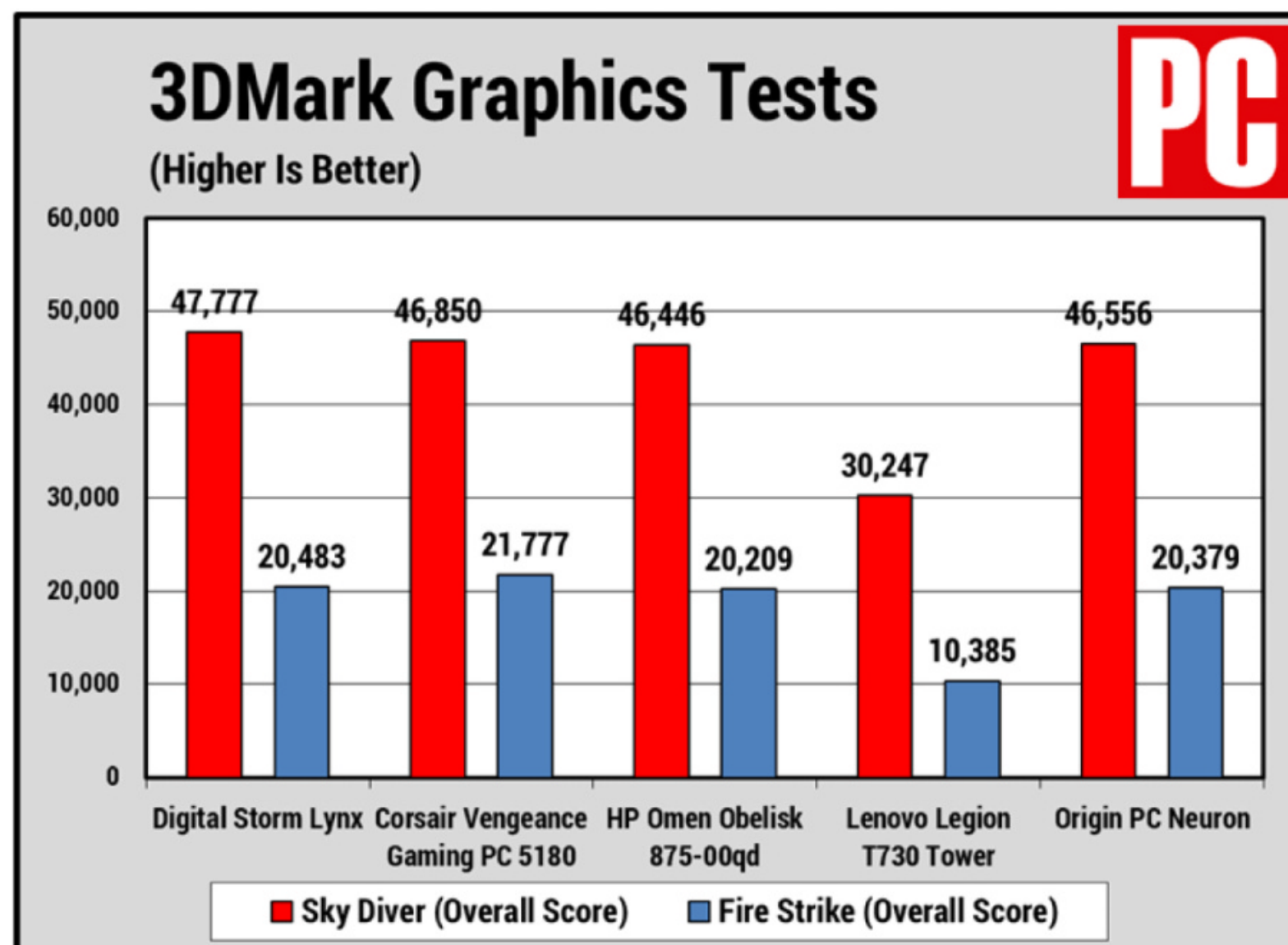
SYNTHETIC GRAPHICS TESTS

3DMark measures relative graphics muscle by rendering sequences of highly detailed, gaming-style 3D graphics that emphasize particles and lighting. We run two different 3DMark subtests, Sky Diver and Fire Strike, which are suited to different types of systems. Both are DirectX 11 benchmarks, but Sky Diver is

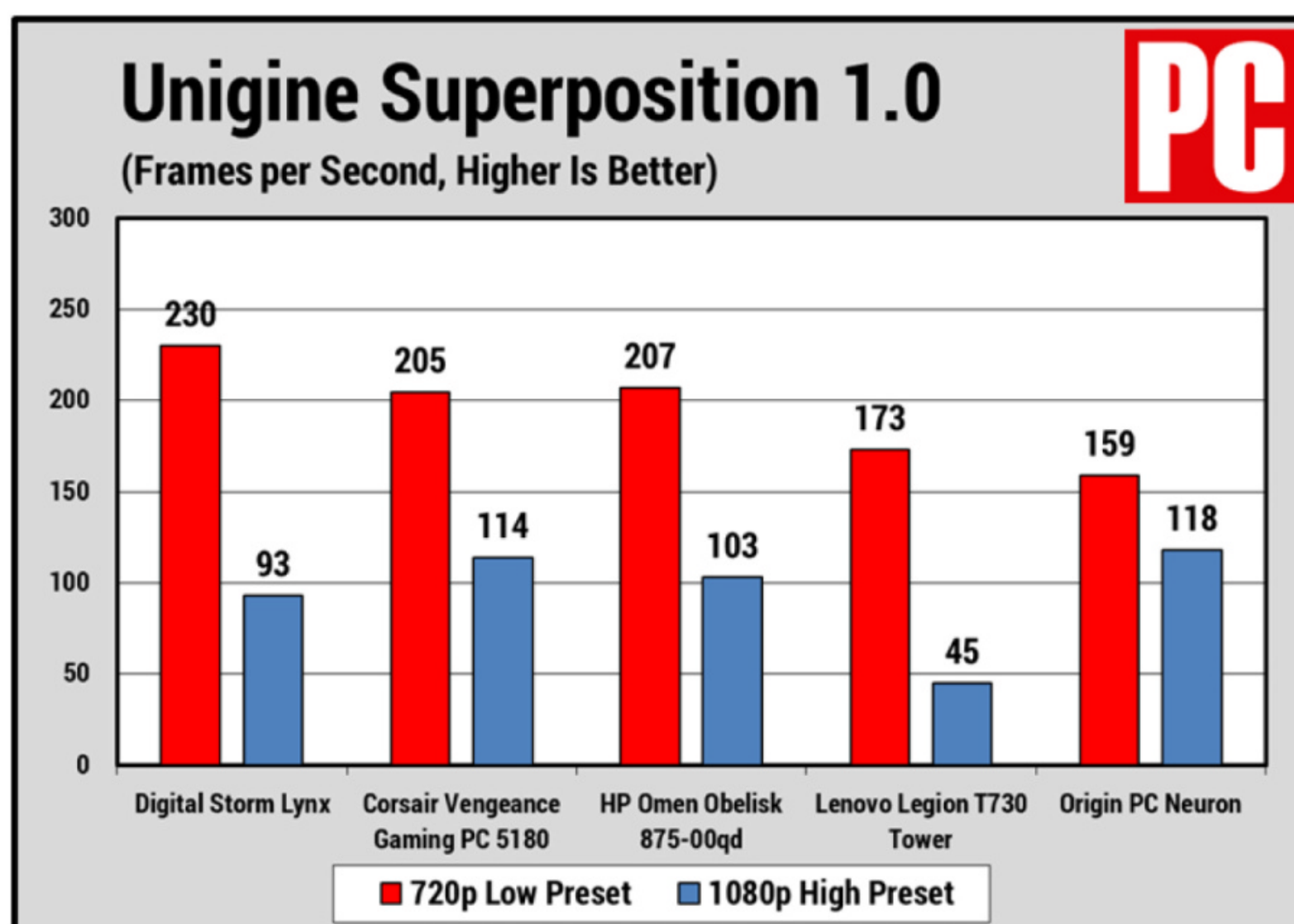
more suited to laptops and midrange PCs, while Fire Strike is more demanding and made for high-end PCs to strut their stuff. The results are proprietary scores.



In the Photoshop test, the higher clocks of the Core i7-9700K helped give the Lynx an undisputed advantage.



Next up is another synthetic graphics test, this time from Unigine Corp. Like 3DMark, the Superposition test renders and pans through a detailed 3D scene and measures how the system copes. In this case, it's done in the company's eponymous Unigine engine, offering a different 3D workload scenario than 3DMark, for a second opinion on the machine's graphical prowess.



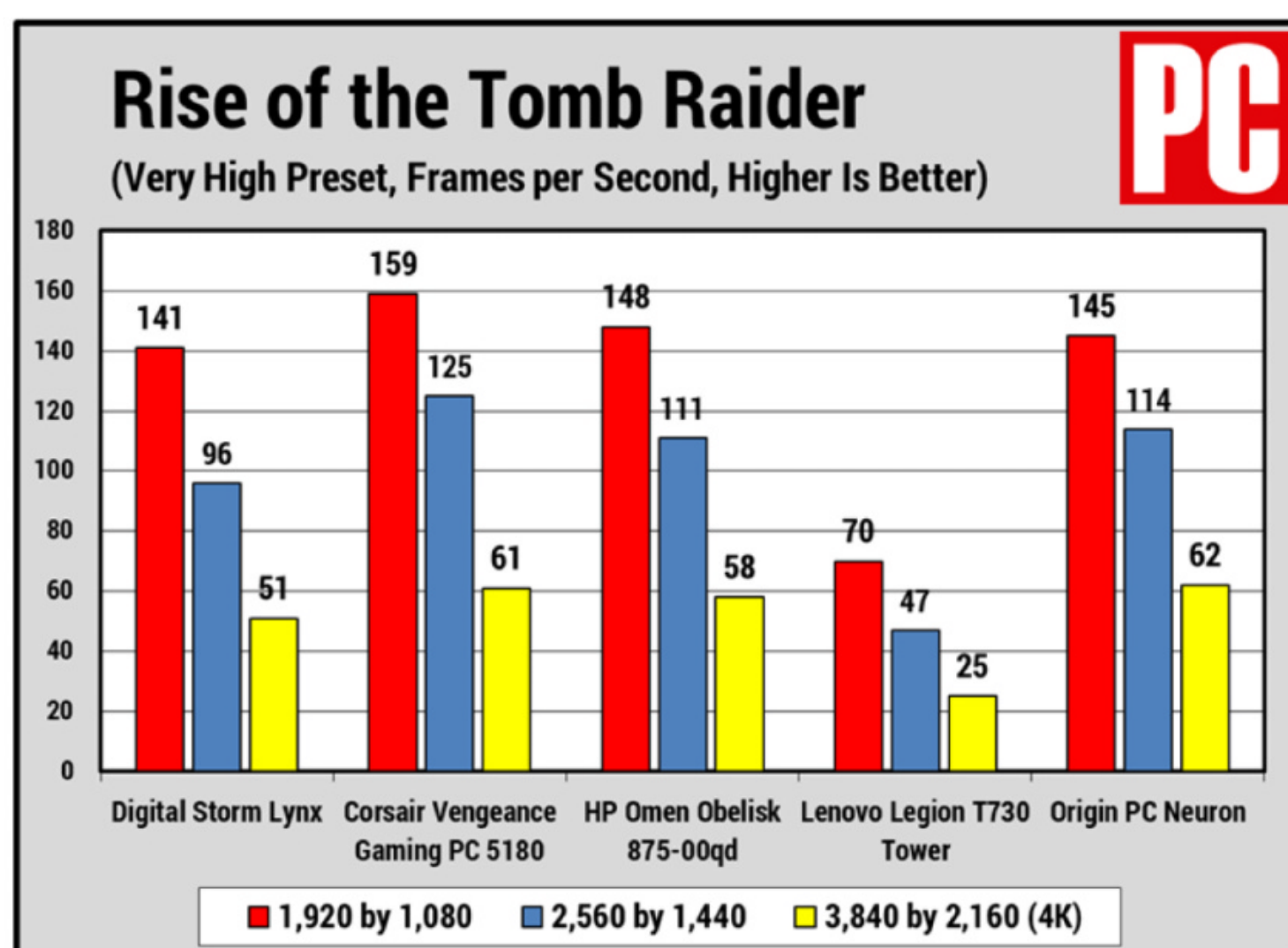
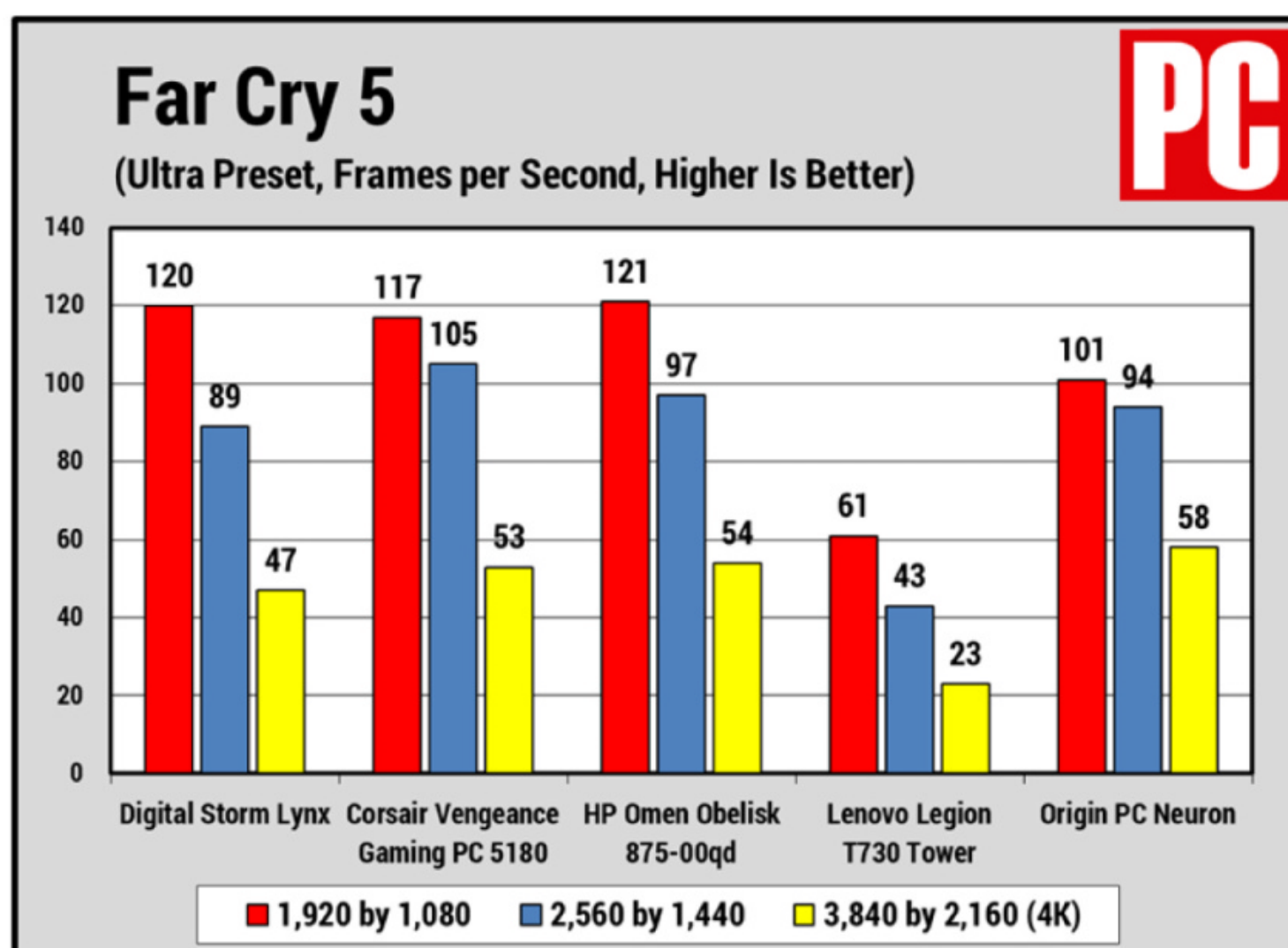
The demanding 3DMark Fire Strike test shows the Lynx and its GeForce RTX 2070 performing almost identically to the GeForce RTX 2080-equipped Corsair, HP, and Origin units. That wouldn't be the case if they all used the same processor; the Core i7-9700K, again, gives the Lynx a serious boost. But the processor can only compensate so much. In the Superposition test, the Lynx trails those three by a significant margin at the 1080p High preset.

REAL WORLD GAMING TESTS

The synthetic tests above are helpful for measuring general 3D aptitude, but it's hard to beat full retail video games for judging gaming performance. Far Cry 5 and Rise of the Tomb Raider are both modern, high-fidelity titles with built-in benchmarks that illustrate how a system handles real-world video games at various settings.

These two games are run on the maximum graphics-quality presets (Ultra for Far Cry 5, Very High for Rise of the Tomb Raider) at 1080p, 1440p, and 4K resolutions to determine the sweet spot of visuals and smooth performance for a given system. The results are also provided in frames per second. Far Cry 5 is DirectX 11-based, while Rise of the Tomb Raider can be flipped to DX12, which we do for the benchmark.

The 1080p and 1440p numbers from the Lynx are outstanding. In fact, it's hard to argue spending extra for a GeForce RTX 2080 to play at those resolutions unless you have a 120Hz or 144Hz gaming monitor.



The Lynx is capable of but not ideal for 4K gaming; that's where you'll need a GeForce RTX 2080 to average near 60fps in these titles with maxed-out settings, as the Corsair, HP, and Origin units plainly show.

COOLING AND THERMALS

The airflow in the Lynx has a highly effective front-to-back design. Three 120mm fans handle fresh-air intake through the front panel, while one 120mm rear fan, plus the fans in the power supply and graphics card, handle exhaust duties. Two of the front-mounted fans are attached to the 240mm liquid-cooling radiator for the processor. I could occasionally hear the fan speed varying with processor load; for example, when I opened an animation-heavy website, I could hear the fans ramp up briefly and then go back down. This behavior was noticeable in a quiet room, making me wish the fan curve was less sensitive.

On the contrary, the fan noise was consistent during our benchmark runs and gaming. Our Lynx isn't a silent machine; there's no motor noise or whine, but four 120mm fans and a blower-style graphics card in a relatively open case design just won't be inaudible. That said, just about any kind of headphones will drown out the sound. Even under full load, the total sound level is unlikely to draw glances from those around you.

For thermal testing under gaming workloads, I used a 20-minute run through the 3DMark Time Spy stress test. The liquid-cooling setup on the Core i7-9700K processor capped its maximum temperature at just 59 degrees C. Meanwhile, the GeForce RTX 2070 graphics card reached 81 degrees C, a normal temperature for a blower-style graphics card. All good there.



**When I opened
an animation-
heavy
website,
I heard the
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then go back
down.**





CONCLUSION: WHY BUILD WHEN YOU CAN BUY?

Shopping for a high-end gaming desktop may snag you in the all-too familiar conundrum of building it yourself, or going with a prebuild. The DIY route gives you your choice of parts and some potential cost savings, while a prebuilt model is hassle-free and covered by a system warranty. Digital Storm strikes a happy medium with the Lynx mid-tower.

The Lynx has all the qualities a desktop might have if you built it yourself and applied lots of TLC, from top-notch aftermarket parts to impeccable wiring and assembly. You'd normally pay a premium over and above the sum of the parts for that kind of action, but according to our attempts to part-shop the components in our "Level 4" Lynx review configuration (as if we were going to build an equivalent desktop), the premium is nominal. You can potentially get a big-brand prebuilt desktop for less money, but you'd be losing out on the custom-built vibe and attention to detail in the Lynx, among other things.

All told, the Lynx makes about as compelling of an argument to go with a prebuilt gaming tower as we can imagine. The only thing you'll miss are the joys of rolling your own, if that's your thing.

CHARLES JEFFERIES



Transparent Language Online: Excellent Education

If you're looking to learn a language, chances are Transparent Language Online teaches it. This online language-learning app has programs for more than 100 languages, from the ones most people are looking to learn to those with comparatively few speakers worldwide. The amount of content varies by language, but on the whole, the programs are thorough. The app also comes with the best speech-analysis tool I've seen. Transparent Language Online is among the best apps for learning a language.

While it's excellent, Transparent doesn't edge out our top two picks for language-learning programs, Duolingo and Rosetta Stone. They're both, in a word, stickier. They compel you to pick them up again day after day

**Transparent
Language Online**

\$199.95 a year or
\$29.95 a month



because they're more fun than the average language-learning app and more visually interesting, too. Still, Transparent is a wonderful program, complete with a mobile app, and it covers dozens more languages than Rosetta Stone and Duolingo combined.

LANGUAGES OFFERED BY TRANSPARENT

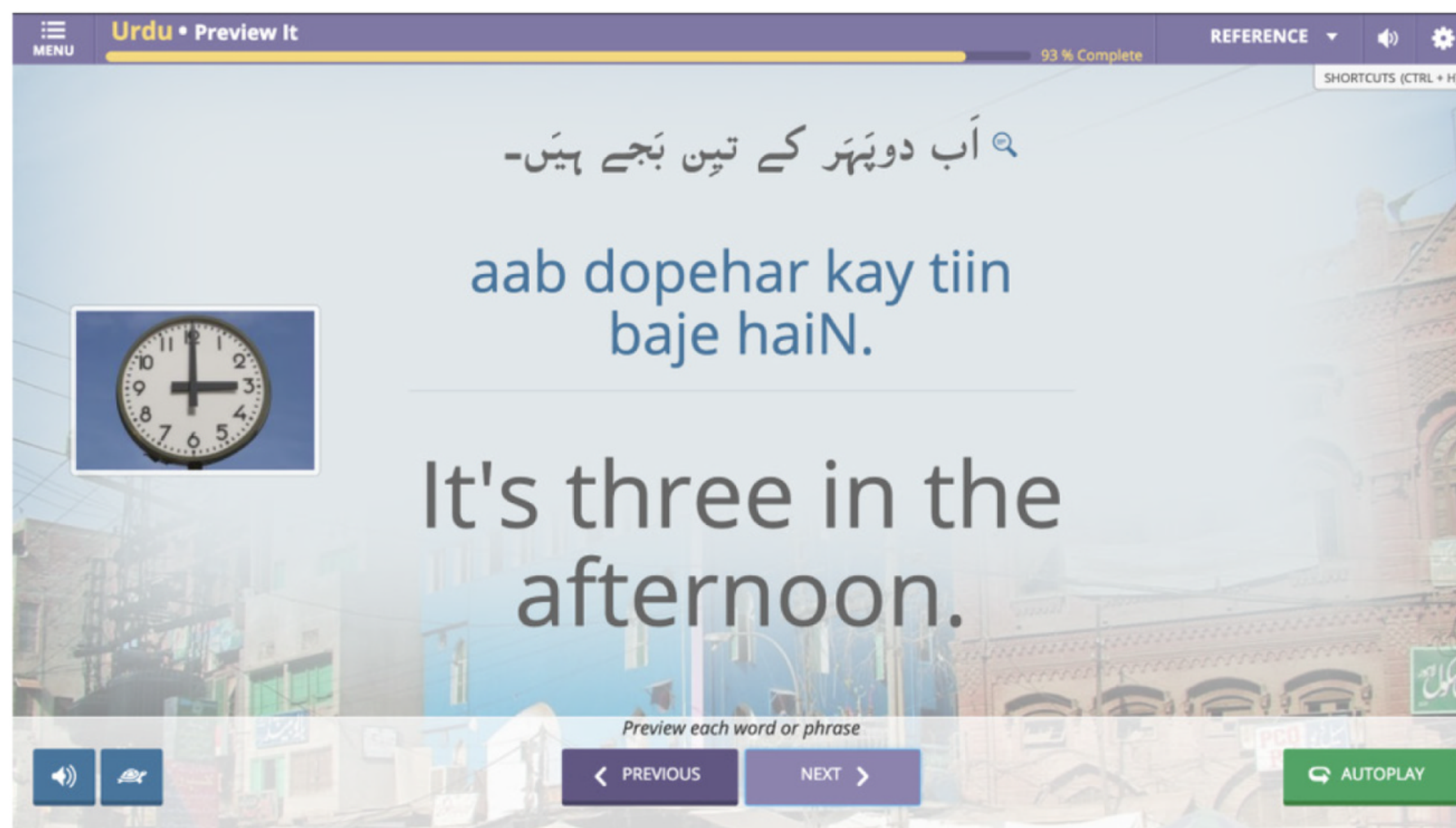
A huge consideration when choosing language-learning software is whether it offers the language you want to study. Transparent has the most of any program I've seen, and that doesn't even include English programs for speakers of other languages.

In the app's long list of languages, some are obscure—Amharic, Baluchi, and Cree are all available, for example. Many of the less-spoken languages have shorter courses and are part of Transparent's 7,000 Languages Program, a nonprofit that aims to make less commonly taught languages available. Popular languages have longer courses.

Transparent Language Online

PROS Offers instruction in more than 100 languages. Clear learning path and structure. Excellent speech analysis. Appropriately challenging.

CONS Writing and spelling exercises could be more polished. Some languages have more content than others. Pricier than others.



If you need to learn a language that Transparent doesn't teach, I recommend either Pimsleur or Mango

Languages. Pimsleur has 50 language programs and is excellent, though it's almost all audio-based. Mango has courses in 68 languages, including some that Transparent doesn't have: American Sign Language, Cherokee, Dzongkha, Igbo, Javanese, Malayalam, Punjabi, Shanghainese, and Yiddish. Mango isn't the strongest program, but it's an option if you're in a bind.

TRANSPARENT LANGUAGE'S PRICING AND PLANS

Transparent Language Online dropped its prices recently to bring them more in line with other language apps. It costs \$199.95 for a one-year subscription, paid up front. If you don't want such a long commitment, it's \$29.95 per month. Transparent also has an offer for people who like to study multiple languages: a subscription to all its languages for \$249.95 per year. A 14-day free trial also gives you access to all the languages. Note that some libraries have licenses to Transparent, so you may be able to access it through your online library portal.

Most other language apps charge somewhere around \$10 to \$12 per month. The exception is Rosetta Stone, which charges \$179 for a yearly subscription, though it often offers substantial deals.

With a subscription to Transparent Languages Online, you get unlimited access to everything that's included in your language program. You can jump around at will, which means you can explore everything that's in the more advanced units before you level up to them. Transparent offers online private tutoring, too, but that's sold separately.

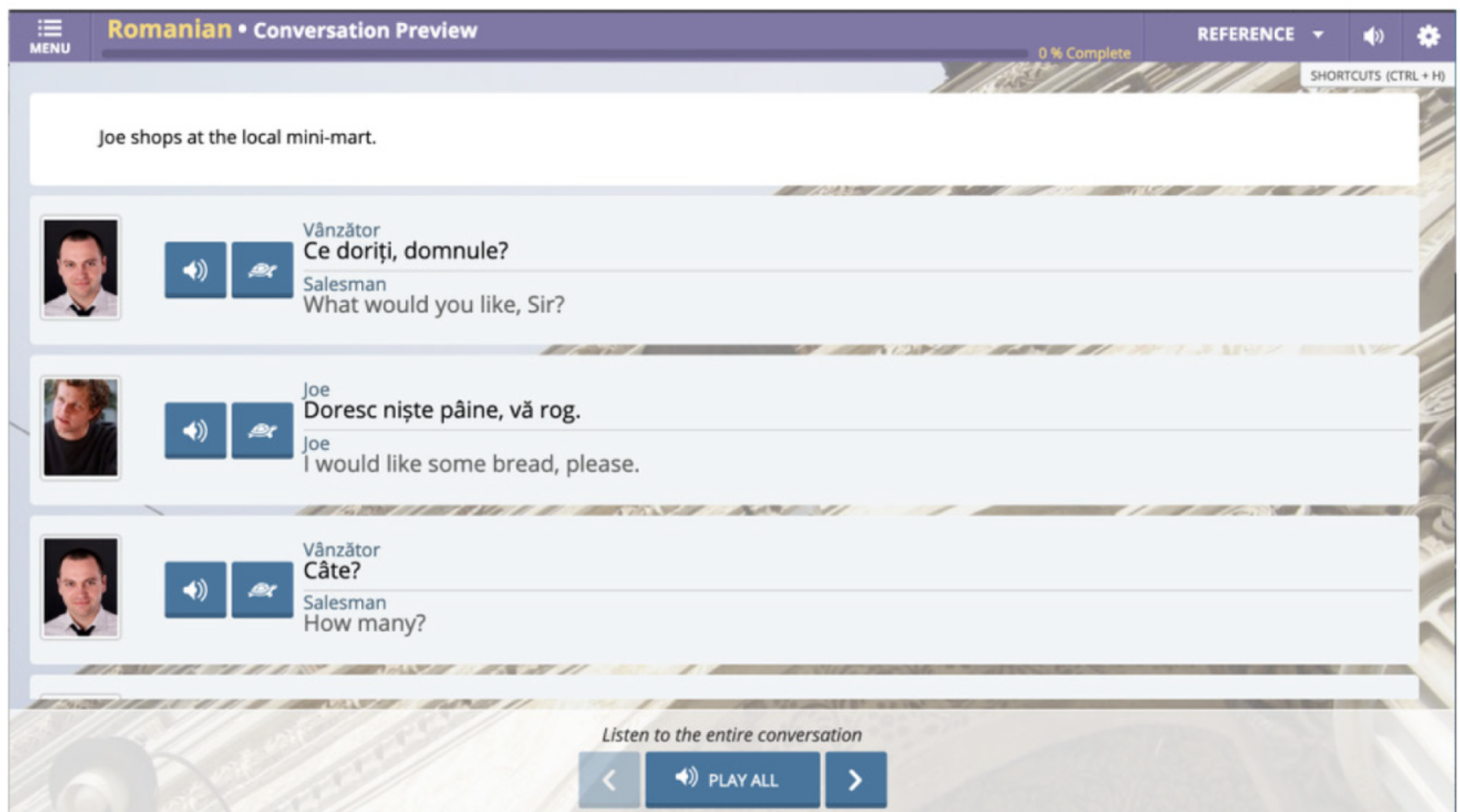
THE TRANSPARENT EXPERIENCE

For me, Transparent presents the right amount of new content at any given time. You aren't overloaded with new words and concepts, but you don't take baby steps the whole time, either.

I've used Transparent Language Online to dabble in German, Russian, and Urdu. I used it most recently to brush up on Romanian. I currently live in Romania, so I'm actively invested in improving my ability in that language. I looked at both the beginner units and the more advanced ones.

Comparing all the language learning apps I've used, Rosetta Stone and Duolingo are the easiest and stickiest, whereas Babel is probably the most challenging. Transparent is somewhere in the middle. I found that picking up

my lessons in Transparent every day takes more internal motivation than either Duolingo or Rosetta Stone does. It isn't clear how many lessons you're supposed to do each day in Transparent, whereas many other programs give you a recommendation. Transparent also isn't visually interesting. That's a minor point, but it discouraged me slightly from wanting to look at the app for half an hour at a time.



TRANSPARENT'S STRUCTURE

Transparent Languages Online starts out with a dashboard. All your units and lessons appear under the heading My Learning Path, and they're sequentially numbered. To the right is a chart that shows your progress in terms of how much vocabulary you've amassed over time. Also in that chart is a number telling you how many words in your vocabulary are stale, meaning you haven't been exposed to them in a while.

My Learning Path tells you about the units and lessons that you'll learn. Each unit contains multiple lessons and ends with an assessment. At any time, you can reveal the vocabulary you're going to learn in the lesson by clicking the ellipsis in the circle and choosing View Contents. If you think the lesson is below your skill level, you can skip ahead to the unit assessment.

Assessment tests are short; they take less than 10 minutes. The program is fussy in terms of accepting an answer typed a certain way. For example, I typed what

I heard as “this t-shirt” when the program wanted “This t-shirt?” with a capital T and a question mark.



**In lessons,
Transparent
gives you ample
variety, with
speaking,
reading,
writing, and
listening
exercises.**



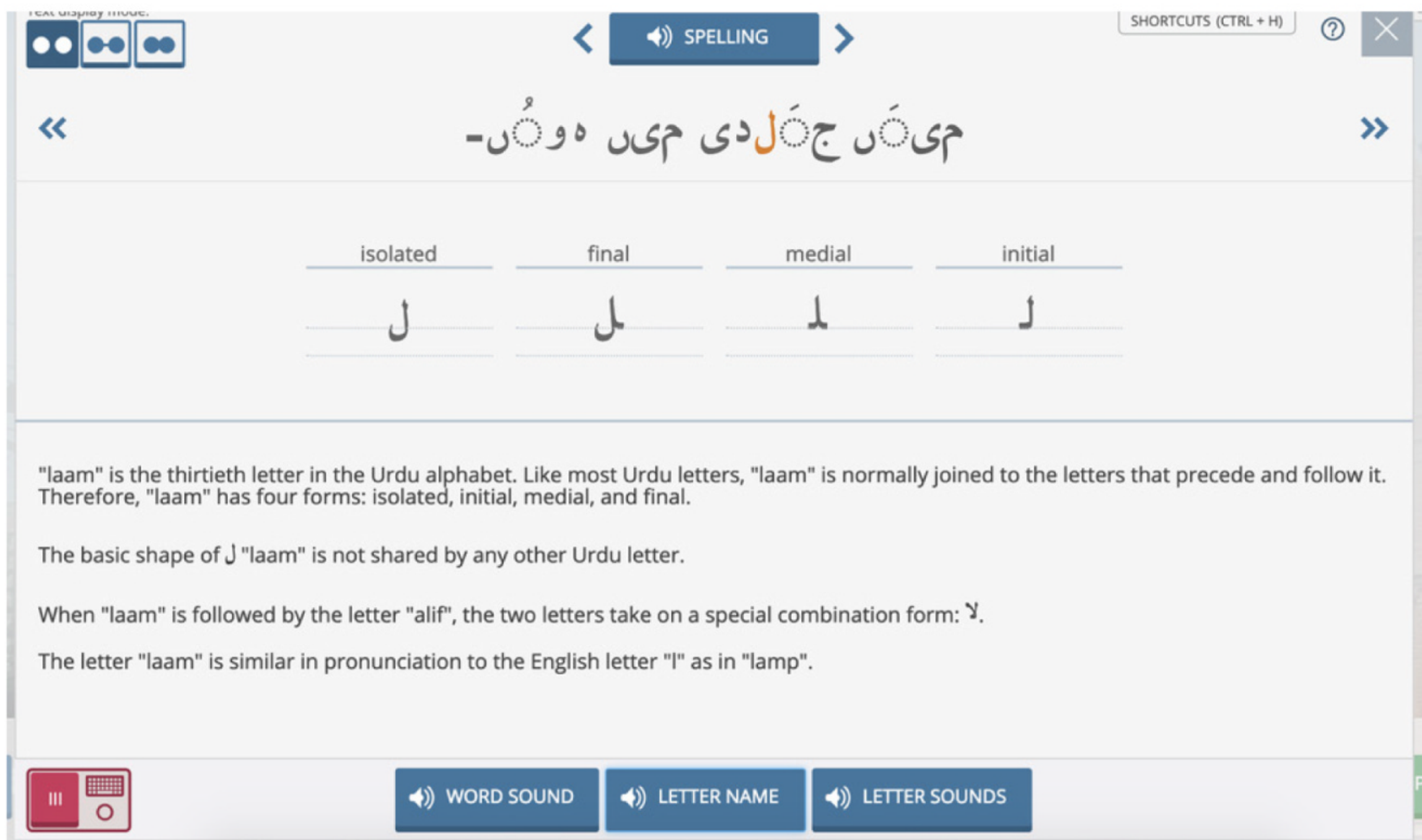
When you’re planning to study a language that uses a different character set, such as Urdu, you have to choose before you even buy the program whether you want native characters or transliterations—meaning the words are phonetically translated into the Roman alphabet (which English uses). If you choose native, though, there are many places where you can still enable transliteration, so it’s not strictly an either-or proposition.

Transparent recently added a new function for languages with new-to-you characters and letters: It lets you see more information about the characters while you’re doing exercises. For example, when you’re learning Urdu, you can click on a word or phrase that you’re learning, and a large pop-up window reminds you of the names and sounds of the letters or characters.

TRANSPARENT’S EXERCISES

As you get into the lessons, Transparent gives you ample variety, with speaking, reading, writing, and listening exercises. They’re fairly routine. My favorite exercise is hearing spoken words and having to transcribe them. My least favorite is called Four Square: Four cards appear on screen, face down. Each card turns over one by one to reveal a word, which you also hear. Then they all go face-down again, and you’re given an English word. You have to remember which card has the Romanian translation. It’s painfully slow and a little too easy.

To practice speaking the language, Transparent has a speech analysis tool. It’s by far the best one I’ve ever seen, and frankly, it took the company years to get right. But now, it’s actually useful. When you practice speaking, you hear a native speaker say a word or phrase. You also see the waveform of their speech. Then you record yourself



saying the same thing. The part worth noticing is that once you finish, the app scores you, and if your score is not up to snuff, it highlights the portions of your waveform graph where you got it wrong. You can then play back your recording and pay attention to the part where your speech did not match the native speaker's. The highlighting combined with the playback make it useful.

How quickly you complete lessons and units is up to you. Each day, you can work through as little or as much as you like. I found two lessons a day to be enough without going at it hardcore. Each lesson took around 10 to 15 minutes, less in the early lessons and more in later ones.

TRANSPARENT'S CONTENT

For languages that are widely spoken, Transparent generally has a lot of content, but it does vary. Romanian has seven units with three or four lessons in each and a grand total of 27 lessons. Very popular languages might have eight or nine lessons per unit. The upside is that each language has a unique program in Transparent. With Rosetta Stone, you get the same program no matter which language you choose; in other words, it doesn't matter whether you're learning Chinese or Spanish: You learn to say "a woman and her dog" in Unit 2.

In addition to lessons, Transparent gives you a lot of ways to practice and review. You can refresh words that have you haven't seen in a while. You can choose to practice a specific skill, such as writing. A tab at the top of the page

called Browse has even more resources and study materials, but again, they vary by language. For Romanian, I got resources for reviewing grammar and the alphabet. But I was disappointed I didn't find anything about grammatical cases, as they're one of the tougher aspects of Romanian.

Transparent doesn't offer longer-form materials such as podcasts or short stories, which are helpful for experienced speakers who need to be pushed past their limits. Duolingo has a Spanish language podcast for learners, and Rosetta Stone offers some good short-story content. And an app called Yabla has videos with subtitles and closed-captioning options that are really useful for more advanced students.

Transparent has a new tool called My Transcript that lets you generate a report of all the work you've done with the program over a certain time period. I suppose it's handy if you need to justify your studies, as with a tutor or teacher.

TRANSPARENT'S STYLE

Most of the learning content hit the sweet spot for me in terms of giving me enough time to remember a new word or grammar tip and then asking me to put it to use. If you work through the activities in order, you'll move among listening, reading, writing, and speaking at a good clip.

The app itself isn't beautiful, as I mentioned earlier. It's functional and smooth, but absolutely nothing about its design will capture your attention. It's just straightforward.



The writing and spelling activities, in particular, solidified some of the things I had learned earlier in a lesson. For example, you might see flashcards teaching you how to say “excuse me.” A few activities later, you must type the phrase for “excuse me.”

Letters not found on American keyboards, such as those with a cedilla (ç) or tilde (ñ), appear on a clickable on-screen

keyboard. Or you can switch to simple typing, which means a selection of letters appear on the screen, and you choose the one that’s needed next. You get simple typing in the mobile app, and while it works, I found it much more jarring and distracting than having a regular keyboard. Smartphone keyboards already have simple and elegant solutions for typing special characters (usually you press and hold a key).

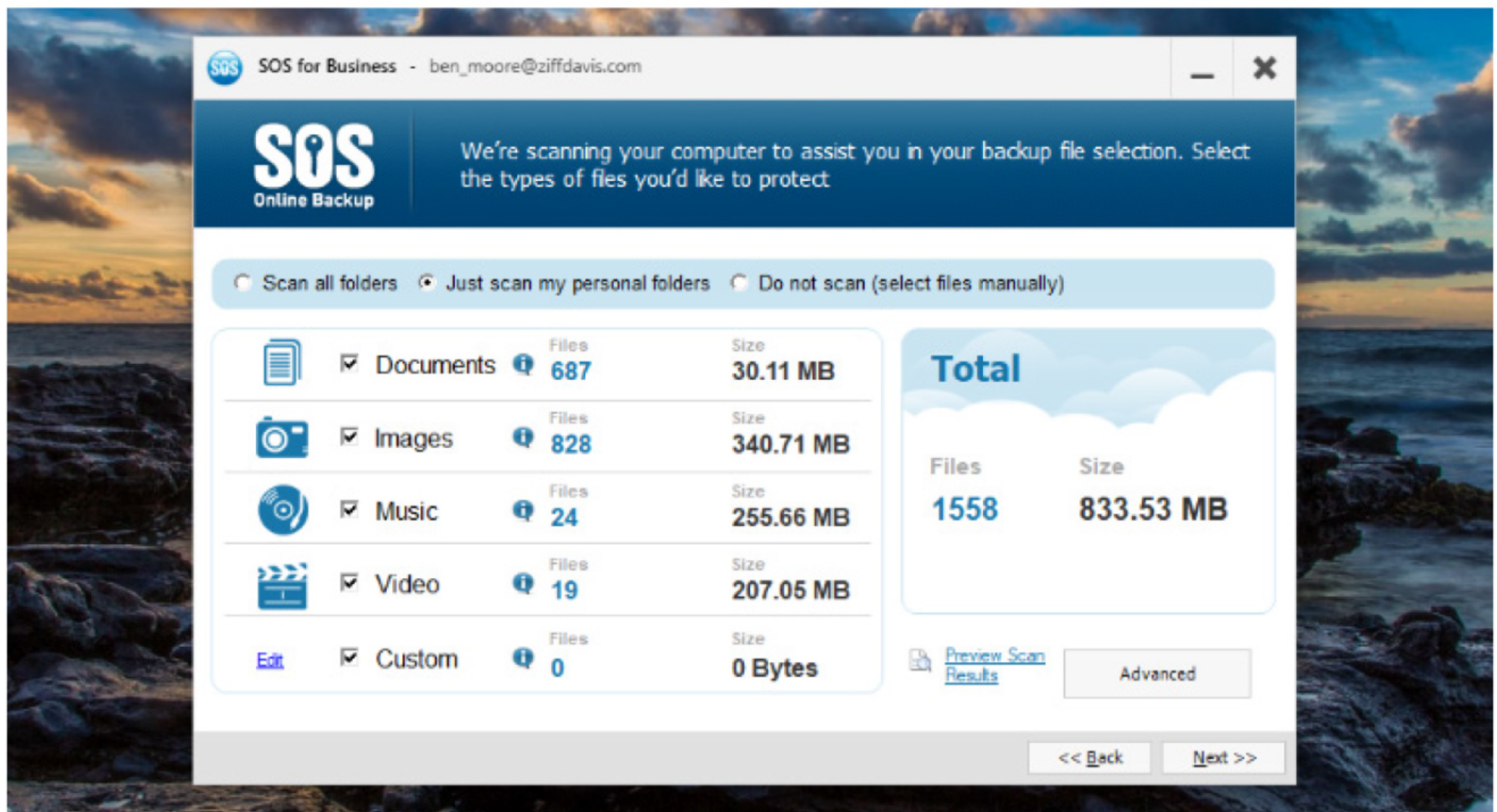


FINAL WORD

The primary reason to choose Transparent Language Online as your language-learning app is that it’s likely to offer the language you need. It’s a solid program for beginners, with an abundance of tools for learning and practicing a new language. At \$199 per year, the price is higher than what you’d pay for other programs, but it’s not wildly above the average.

Rosetta Stone has a more deductive learning technique, a slower pace, and more visual appeal, all of which contribute to making it our Editors’ Choice among paid language-learning programs. Duolingo is our Editors’ Choice for free language-learning programs. Transparent is excellent, however, and offers many more languages than Rosetta Stone and Duolingo combined, so it’s a top choice too, especially for languages that are hard to find elsewhere.

JILL DUFFY



SOS Online Backup: Top Security and Archiving

SOS Online Backup offers more advanced security options than most other online backup services, as well as some special features, including the ability to back up concurrently to a local folder and to truly archive your files. We also like that a single license is good for several computers and unlimited mobile devices, but its storage rates are expensive. Beyond price, our only complaint with this otherwise excellent service is that its desktop and mobile apps are in need of a design refresh.

SOS Online Backup

\$4.99 per month or
\$44.99 per year



PRICING AND PLANS

SOS is one of the most expensive online backup options we've reviewed: For \$4.99 per month or \$44.99 per year, you get only 50GB of storage. Paying \$7.99 per

month or \$79.99 per year bumps the limit up to 100GB. Plans are available all the way up to a whopping 10TB for \$299.99 per month or \$2,999.99 per year. Interested users can sign up for a 15-day free trial account, which doesn't require a credit card.

By comparison, IDrive gives you 2TB of space for an unlimited number of computers at \$69.50 per year. Backblaze offers an unlimited storage plan for \$60 per year, but a license protects just one computer. SOS doesn't offer a free storage plan, unlike IDrive and Zoolz BigMind's 5GB free accounts.

The SOS Online Backup software is available for Windows (Vista SP2 and newer) and macOS (10.8 and later). To cancel an account, you must contact the SOS support team, which will submit a formal ticket to the billing team. You will get a confirmation email of this request, but this is still more of a roundabout method than we prefer.

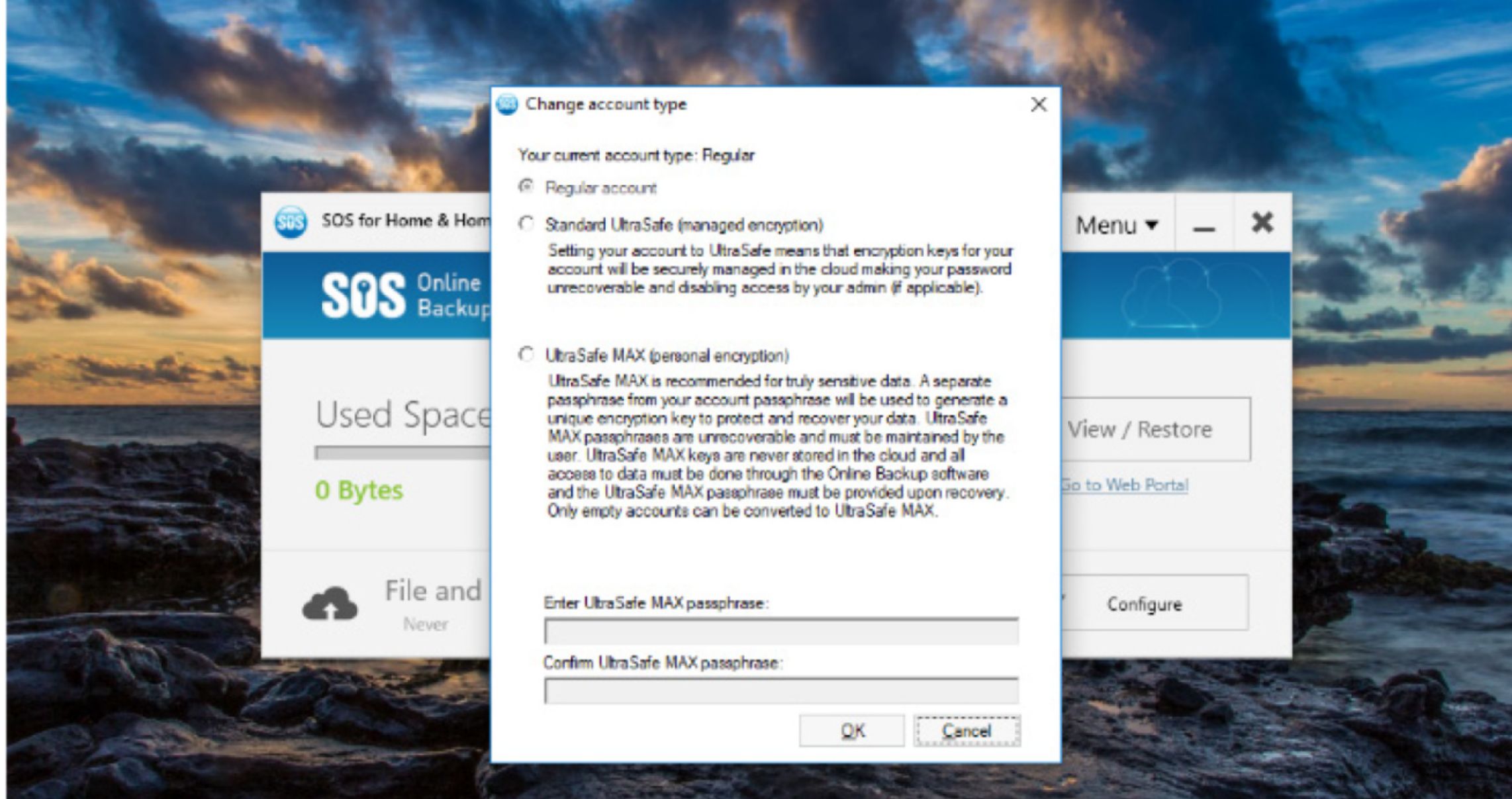
SECURE STORAGE

SOS offers a few options when it comes to protecting your backups. After entering an account email and password, you can use standard password security, in which your encryption key is maintained on SOS Online's servers. You can also pick one of two ultra-secure choices: Standard UltraSafe and UltraSafe Max. With both of these options, you won't be able to reset your password if you lose it. Also, whereas the UltraSafe option uses a random key to encrypt your files, the UltraSafe Max option requires you to maintain a local encryption key. You can switch between account types later, but you need to delete any backup sets first. SOS Online Backup says it encrypts locally prior to transfer with AES-256 encryption, then encrypts during transit with 256-bit SSL, then encrypts it one more time using the AES-256 standard once it's at rest on an SOS server.

SOS Online Backup

PROS Robust security options. Archival features. Can back up external and network drives. Local backup.

CONS Outdated desktop and mobile interfaces. Continuous protection limited to individual files. No File Explorer integration. No free or unlimited storage accounts.



Besides making it impossible to retrieve your password, the UltraSafe Max option doesn't allow you to use the web portal or mobile devices. You alone possess the password for decrypting your backed-up data. Managing your own key prevents the company from handing over your data to law enforcement, even if it's compelled to by a warrant. But if you lose the key, even SOS employees won't be able to retrieve your data in an unencrypted state, so it's probably smart to have a password manager remember it for you. For all but the most privacy-minded, choosing standard is probably a good idea.

Speaking of passwords, SOS Online Backup does support two-factor authentication, but you have to jump through a few hoops to enable it. Basically, you need to fill out your user information in the Manage section of the website (which we discuss later) and then submit a request to a representative. Other services, including Carbonite, Backblaze, and IDrive, allow you to enable this much more easily with a dedicated option in the settings section of their respective web interfaces.

SOS Online Backup is a product of Infrascade, a company based in California. Infrascade's privacy policy states that it collects a few categories of information—namely, account data and system metadata. SOS uses this data to contact you as well as to provide and improve its services. We appreciate Infrascade's statement: "We do not sell or rent Customer Data or Personal Information to anyone." Note that it retains the right to share data with third parties to maintain or provide its services or to comply with law enforcement "when required by a subpoena, court order, search warrant, [or] other legal process." This is all standard practice.

START SAILING

With the security decision out of the way, SOS's backup wizard launches. It preselects all documents, photos, music, and videos, but you can change this selection later. SOS conveniently calculates the total space required and the number of files selected at this stage. The next screen shows a file browser from which you can customize the selection further and add data filters. You can also choose to include network or external drives for backup. The sky is pretty much the limit—there are no file size or type restrictions on uploads.

Next, it's time to choose a schedule for the backup, which can be anything from hourly to monthly. From the scheduling screen, you can direct SOS to concurrently back up files to a local folder as well as specify how long it keeps files online after they are deleted or if they go unedited for some time on the local machine.

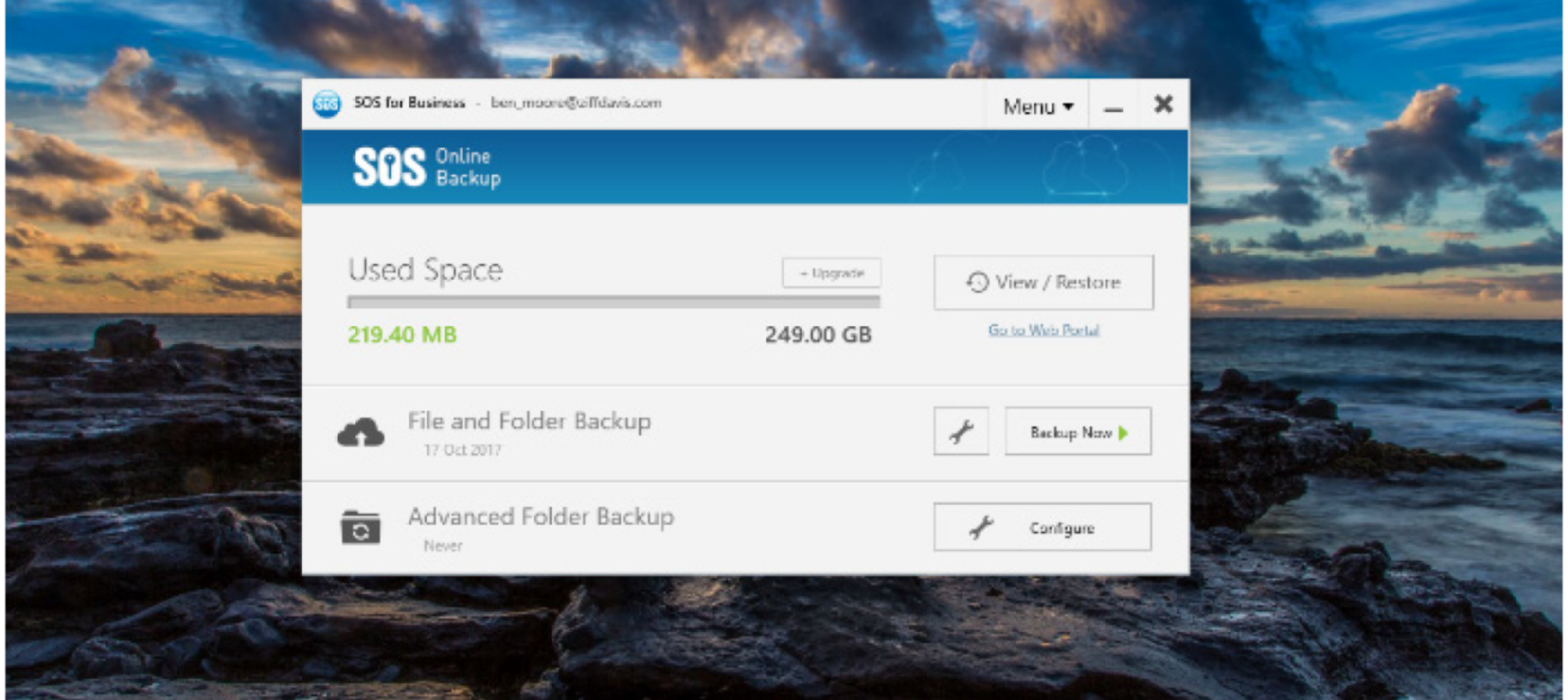
SOS doesn't offer a true continuous backup option for the entire backup set, unlike some of its competitors. For crucial files, you can right-click and choose Enable LiveProtect. When you do this, a new version of the file is automatically uploaded to online storage every time you change the original. Other services, including Carbonite and Backblaze, make this much simpler (continuous backup applies to all files in the backup set), and we would like to see this feature reworked.

When the backup process starts, a new dialog pops up that shows its progress and even which file it's currently processing. You can pause the process, but there's no estimate of how long the whole operation will take. Advanced options let you throttle the data usage by megabytes per day, in case you have ISP data limits. Note that SOS home users cannot back up disk images, which is something that IDrive and Acronis True Image allow you to do.



The sky is pretty much the limit—SOS Online Backup has no file size or type restrictions on uploads.





DESKTOP INTERFACE

The desktop application on Windows is functional, but it has not been updated since the time of our last review. As such, many of its elements continue to look dated. For example, the primarily gray interface is bland, and you can't resize most windows. Additionally, the font in the Advanced Options menus is difficult to read. We do like the main interface's prominent Remaining Storage indicator and Backup Now button.

When you click the wrench icon to the right of the File and Folder header, it takes you through the same backup wizard as when you first set up the software, each and every time. We wish you could access specific options more easily.

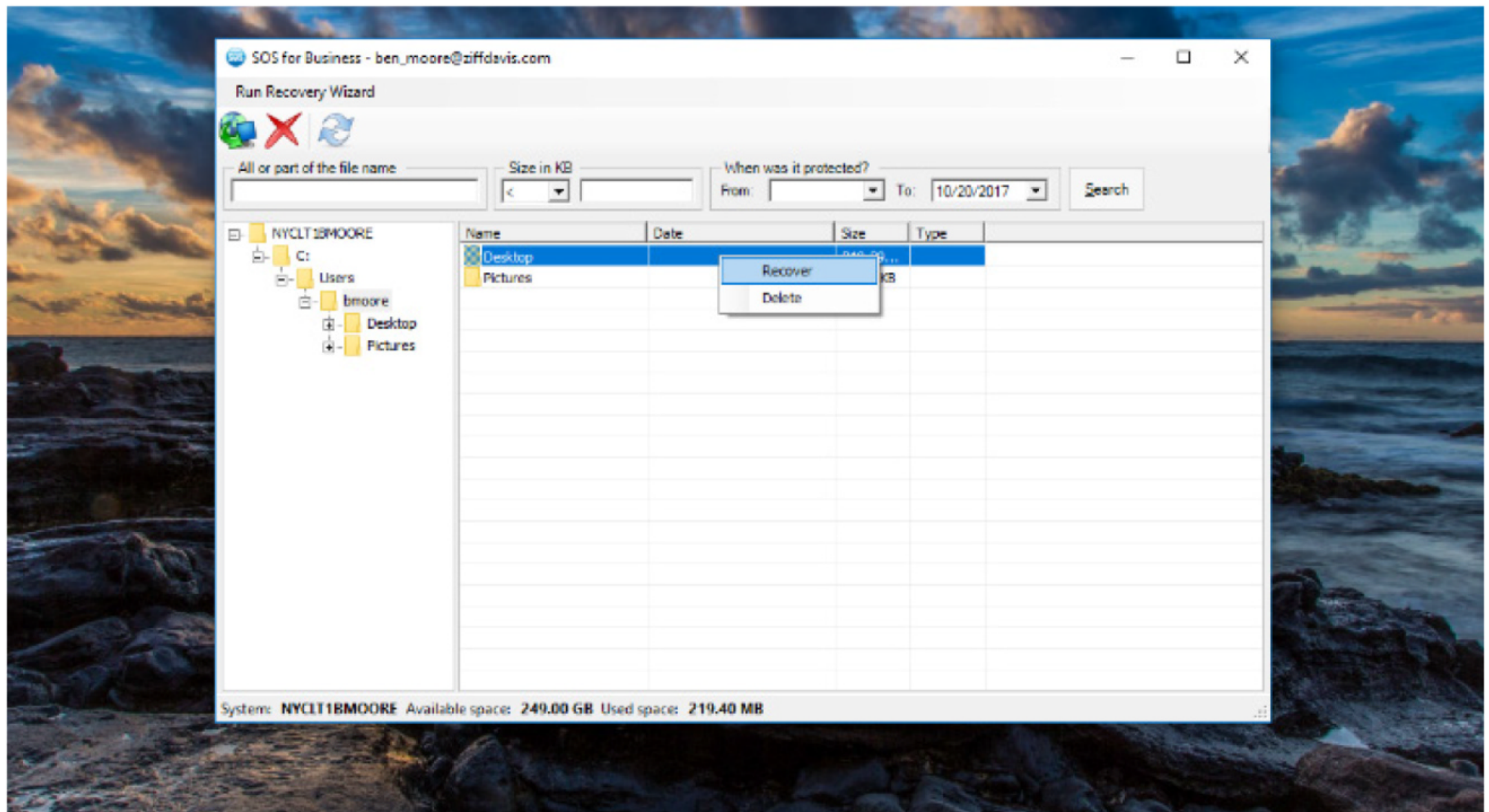
New to the latest version of SOS Online Backup is an Advanced Folder Backup option, which lets you set up folders on different backup schedules and specify some new retention policies, such as Replicate or Forever Save. You can even set files to stay online temporarily or schedule their local deletion and subsequent upload to cloud storage.

SOS still doesn't have right-click options in File Explorer menu, which Carbonite and IDrive both offer. Also, it presents a Taskbar notification-area icon only while backups are running, whereas other services leave an always-accessible icon here.

RECOVERING FILES

SOS Online's recovery tool is highly functional and is one of its best features, although—again—its design is dated. To access this module from the desktop application, just click the View/Restore tab from the main screen. You can

search for particular files, browse a folder tree, or simply restore your entire backup to the My SOS Restores folder, with the original folder structure optionally preserved. You can recover all versions of a file by selecting a simple checkbox or use a calendar to get files back from a particular day. You can also remove files from your backup in this section by right-clicking on an item and hitting Delete.



One of SOS's claims to fame is that it saves all previous versions of all backed up files. Most other services that save versions keep them only for a specified time. For example, Acronis True Image keeps the previous 20 versions of a file, but just for six months. IDrive keeps the previous 30 versions indefinitely. SpiderOak ONE matches SOS Online Backup by keeping an unlimited number of versions of the files you upload.

SOS also functions as an archival service; even if you delete a local file on your backup, you can set SOS to retain files online for a specified period. IDrive and Acronis also offer archival features. We tested SOS Online's ability to save all versions of a file by repeatedly editing and saving a Microsoft Word document that was protected by LiveProtect. In the recovery dialog is a drop-down arrow in the file's Date field that gave access to all the earlier versions. Note that you have to refresh the Restore list before those prior versions show up.

An SOS Online Backup representative confirmed that users can submit a request for a bulk upload or download via a mailed drive. This could be useful in the event that your hard drive gets destroyed or you just want to speed up the initial backup process. The representative noted that the standard rate for this service is \$300 plus shipping. IDrive, Carbonite, and Backblaze all offer similar services for a lower cost.

NAVIGATING THE WEB CLIENT

SOS's web dashboard presents an overwhelming amount of information, although it is quick to navigate. Still, the interface feels enterprise-focused, and users just starting out may feel lost. Advanced users will appreciate the flexibility, but Carbonite's web presence is much more approachable for most home users.

The homepage displays an overview of completed backups, account details and access to your cloud data. Additional features include a Monitoring tab, which shows the backup status and detailed information on every linked device; and a Reporting section, which lists the details of every backup task ever performed. This console also allows you to delete or share files directly from your online storage, though it does not allow you to password-protect shared files. SpiderOak ONE and Zoolz BigMind offer much more flexibility.

In the Settings > Backup Accounts section, you can specify account quotas, limit the number of file versions kept, and disable sharing capabilities entirely. Note that you need to add user information in the Manage tab before you can request that two-factor authentication can be added to any account.

BACKUP SPEED

We tested SOS Online's backup speed by uploading three separate 1GB file sets and timing how long the uploads took to complete. Next, we calculated the average of those three times for the purpose of comparison.

We used PCMag's fast (600 Mbps upload) Ethernet connection so bandwidth wouldn't be a factor; we're testing the performance of the software and the company's servers. Our test machine for all services was a Lenovo Ideapad 320 running Windows 10.

| Average Time to Upload 1GB (mm:ss) | |
|------------------------------------|-------|
| <i>IDrive</i> | 01:25 |
| Zoolz Big Mind | 01:44 |
| OpenDrive | 02:35 |
| <i>Acronis True Image</i> | 02:38 |
| SOS Online Backup | 06:42 |
| Backblaze | 07:47 |
| Carbonite | 15:55 |
| SpiderOak ONE | 19:02 |
| Livedrive | 27:11 |

**Red Italics denotes Editor's Choice service*

SOS Online's result of 6:42 (mm:ss) is a middle-of-the-pack score. IDrive took the top spot, with a time of 1:25, while Zoolz BigMind's result of 1:44 was not too far behind. SOS Online Backup's speed was comparable with Backblaze's (7:47) but much quicker than that of SpiderOak ONE (19:02) and LivedriveFree at iTunes Store (27:11). The speed of your online backup service is not the most important factor you should consider when choosing a backup service, but it can make the initial run less disruptive to your work.

MOBILE BACKUP

SOS offers apps for Android (2.2 and later) and iOS (6.0 and later). We had no issues signing into our test account on a Google Pixel running Android 9. Note that if you start your SOS account through an app, you get a free 5GB storage allotment (currently Android only). The main app interface is split into four sections, My Cloud, Protect, My Downloads, and My Favorites, but there's a ton of wasted space and the icons look old. Acronis True Image's and IDrive's apps look much more modern.

The app lets you back up images, videos, music, and files from the mobile device, as well as view and download all the files in your cloud backup. Some mobile apps, such as Backblaze and SpiderOak ONE, do not allow you to back up device data, so we appreciate this inclusion. We also like that you can sort files by name, size, date, and type, which is something many apps also completely omit. There is no search functionality though in the Android app (though the iOS variant has this), which is problematic for people who need to find specific files in large backup sets.

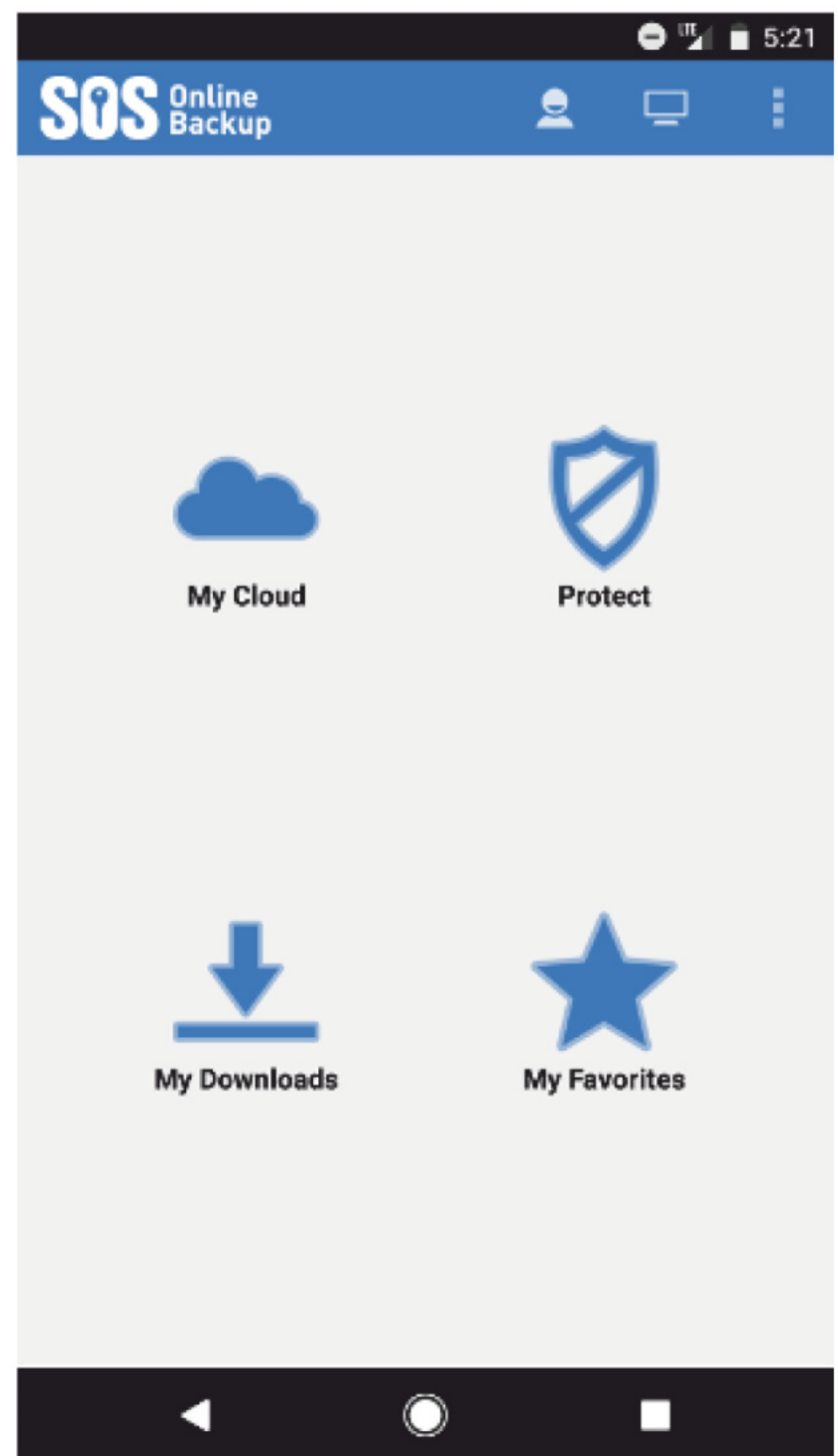
SOS Online Backup is missing other functionality too. For example, you can't share files from the mobile app, and there aren't any options for biometric

logins, two-factor authentication, or a passcode lock on the mobile app, either. For a security-focused backup service, this is disappointing. In fact, the only available options are for limiting data usage to Wi-Fi and a few for setting restore preferences. We wish SOS would put more work into the mobile experience, as it has fallen well behind top competitors in terms of usability.

SOS MAY SAVE YOUR SHIP

SOS Online Backup offers excellent security features, saves all previous versions of files, and is very flexible. However, this service costs much more than competitors and its apps haven't been updated significantly in recent years. It's no longer an Editors' Choice winner, but it is still a very good online backup service. We recommend Editors' Choice service IDrive, for its value, and Acronis True Image, for a superior interface and feature set.

BEN MOORE, MICHAEL MUCHMORE



FEATURES

THE NEW ENTERTAINMENT GIANTS:

WELCOME TO THE
CONTENT-INDUSTRIAL
COMPLEX

BY ROB MARVIN



HOLLYWOOD

Jeffrey Cole thinks the consumer “is about to get screwed.”

For millions of viewers, our primary means of entertainment has shifted from movie studios and traditional cable providers to video streaming services and the seemingly infinite piles of content they beam to every device with a screen. Now, as corporate battles fortify the streaming landscape into walled-off apps, consumers are faced with a growing number of monthly subscription options to access each service’s exclusive shows and movies.

“Consumers have gotten a phenomenal deal: \$10 a month from Netflix to get the studio television shows, the originals, and movies from Paramount, Warner Bros, Universal, Disney; the list goes on,” said Cole, a research professor at the USC Annenberg School for Communication and Journalism, and Director of USC’s Center for the Digital Future. “In three years, they’ll have to pay \$40 or \$50 to replicate that” across several services.

He’s not wrong. Newly melded media conglomerates and powerful Silicon Valley players, including Apple, are gearing up to battle Netflix, Amazon, and Hulu with their own standalone streaming services. Every time a new one crops up, the promise of cord cutting—replacing hundreds of channels you never watch and hefty cable bills with one streaming service that costs \$10 per month—becomes less tenable.

This merging of new and old was on display in January, when Netflix joined the Motion Picture Association of America (MPAA), an organization that’s long been synonymous with big-budget entertainment—Disney, NBCUniversal, Paramount, Sony, 21st Century Fox, and Warner Bros. “All of our members are committed to pushing the film and television industry forward, in both how we tell stories and how we reach audiences,” MPAA Chairman and CEO Charles Rivkin said at the time.

But as the MPAA opens its doors to the company that upended the power balance in the entertainment world, the companies it disrupted are merging, consolidating, and rolling out competing streaming services to take on their deep-pocketed Silicon Valley rivals.

In this PCMag Digital Edition cover story, we break down the escalating war for original content and the tectonic shifts in an industry that’s straddling the

media, tech, and entertainment worlds. We spoke to execs from Amazon Prime Video, CBS, Disney, and Hulu, as well as experts and analysts. Netflix declined multiple interview requests; HBO and Turner initially agreed to participate but dropped out amid corporate upheaval and executive shuffles.

THE RACE TO BEAT NETFLIX

Despite—or more aptly, because of—Netflix, Amazon, and Hulu’s collective dominance, newly melded media conglomerates and powerful Silicon Valley players like Apple are gearing up to launch their own standalone streaming services in the next year.

One imposing shadow on the horizon is Disney, fresh off its \$71.3 billion merger with 21st Century Fox and boasting a three-pronged streaming strategy with its forthcoming Disney+ service, ESPN+ app, and now-majority stake in Hulu. Comcast-owned NBCUniversal is also planning to launch a streaming service in 2020. CBS owns both the CBS All Access and Showtime streaming apps. And AT&T’s long-gestating acquisition of Time Warner is finally coming to fruition: Its exclusive streaming app combines the content of HBO, Warner Bros, Turner’s TV channels, and more under a single subscription.

Finally there’s Apple, which has spent billions over the past two years on original content, recruiting top talent including including Oprah, Steven Spielberg, and countless other A-list actors, directors, and showrunners. The company plans to launch its own streaming service, which is rumored to be a low-cost, family-friendly option that will be free for iOS and Apple TV users.



Every time a new streaming service launches, the promise of cord-cutting becomes less tenable.

Ultimately, all of this creates an increasingly strained value proposition for consumers. Viewers have more options, but catching every new series means subscribing to several services and taking on more monthly costs. In an industry purpose-built to capture viewers' attention, content is the resource that fuels the machine; it's what keep consumers coming back for the next episode.

THE ESCALATING ORIGINAL CONTENT WAR

In a streaming landscape where most of the companies with content to license are pulling it back onto their own services, originals are becoming ever more important—not only to fill out a service's content library but also to differentiate from the competition with series, films, comedy, documentaries, and established entertainment brands, to entice users to subscribe and keep them coming back.

The original content arms race begins and ends with Netflix. The company ramped up its overall content spending from \$9 billion in 2017 to \$12 billion in 2018 and an estimated \$15 billion in 2019, which ensures there's never a lull for viewers. After a subscriber watches a dozen shows they've added to their list or seen pop up in recommendations, 20 more are coming.

“All of a sudden, studios that used to be standalone businesses—in the era where one hugely expensive unsuccessful film could bankrupt a studio—got bought by bigger companies, and now we're entering the era of the trillion-dollar companies,” said Cole.

Netflix's cash burn is a long-term investment in the original content it owns, ensuring the company will never be as beholden to other companies' content in the future as it was at its start. In Q4 2018, Netflix's free cash flow (the money it generates to cover its expenses) hit a deficit of \$1.32 billion, up from \$524 million in Q4 2017.

But Netflix expects its cash burn to peak this year and then start to go down. The company has shown more willingness to cancel shows in the past year as it begins to slowly prune its glut of originals. According to Cole, the Digital Center's research found that Netflix spent about \$12 billion on programming in 2018 (around \$8 billion of that on originals), Amazon spent \$6 billion with plans for another \$6 billion in 2019, and HBO spent over \$2.5 billion in 2018; AT&T plans to scale that up this year.

“The whole Netflix system works until they stop growing,” said Cole. “Or until Jeff Bezos decides he’s tired of all the competition and ups that six to \$20 billion. Now there’s Apple is saying, ‘Maybe we should be in this business.’ So they go and they hire two of the best executives from Sony Television, bring them over and say, ‘Let’s dabble. Oh and by the way, here’s \$2 billion.’”

Some of the most visible collateral damage in the original content war is the cancellation of Netflix’s entire slate of Marvel TV series. *Daredevil*, *Jessica Jones*, *Luke Cage*, *Iron Fist*, and *The Punisher* run on Netflix, but they’re produced and owned by Disney, which will pull all of its content off rival streaming services at the end of this year.

Regardless of how popular the shows were (or how great the third season of *Daredevil* was), they were expensive to create, and it didn’t make financial sense for Netflix to keep paying for them.

Disney is leaving the door open to bring the shows back on Disney+, though. Marvel Television Executive Producer Jeph Loeb wrote a letter to fans that simultaneously took a jab at Netflix and teased possible revivals: “Our network partner may have decided they no longer want to continue telling the tales of these great characters, but you know Marvel better than that...To be continued...!”

As Netflix gets out of the Marvel business, the now-Disney-controlled Hulu is doubling down on it. Hulu already has Marvel’s *Runaways* and recently struck a deal to bring four standalone animated series to life (*Howard the Duck*, *Tigra & Dazzler Show*, *Hit-Monkey*, and *M.O.D.O.K.*) and a Defenders-style crossover animated series uniting them as *The Offenders*.



“Animated shows connect deeply with legions of fans, which is exactly why Hulu has curated the largest collection of animated content for adults, with shows like *Family Guy*, *Bob’s Burgers*, *King of the Hill*, *Rick & Morty*, and *South Park*,” said Beatrice Springborn, VP of content development at Hulu. “It’s the perfect time to expand our partnership with Marvel Animation to four new series and a special from Marvel’s celebrated collection of superheroes and villains.”

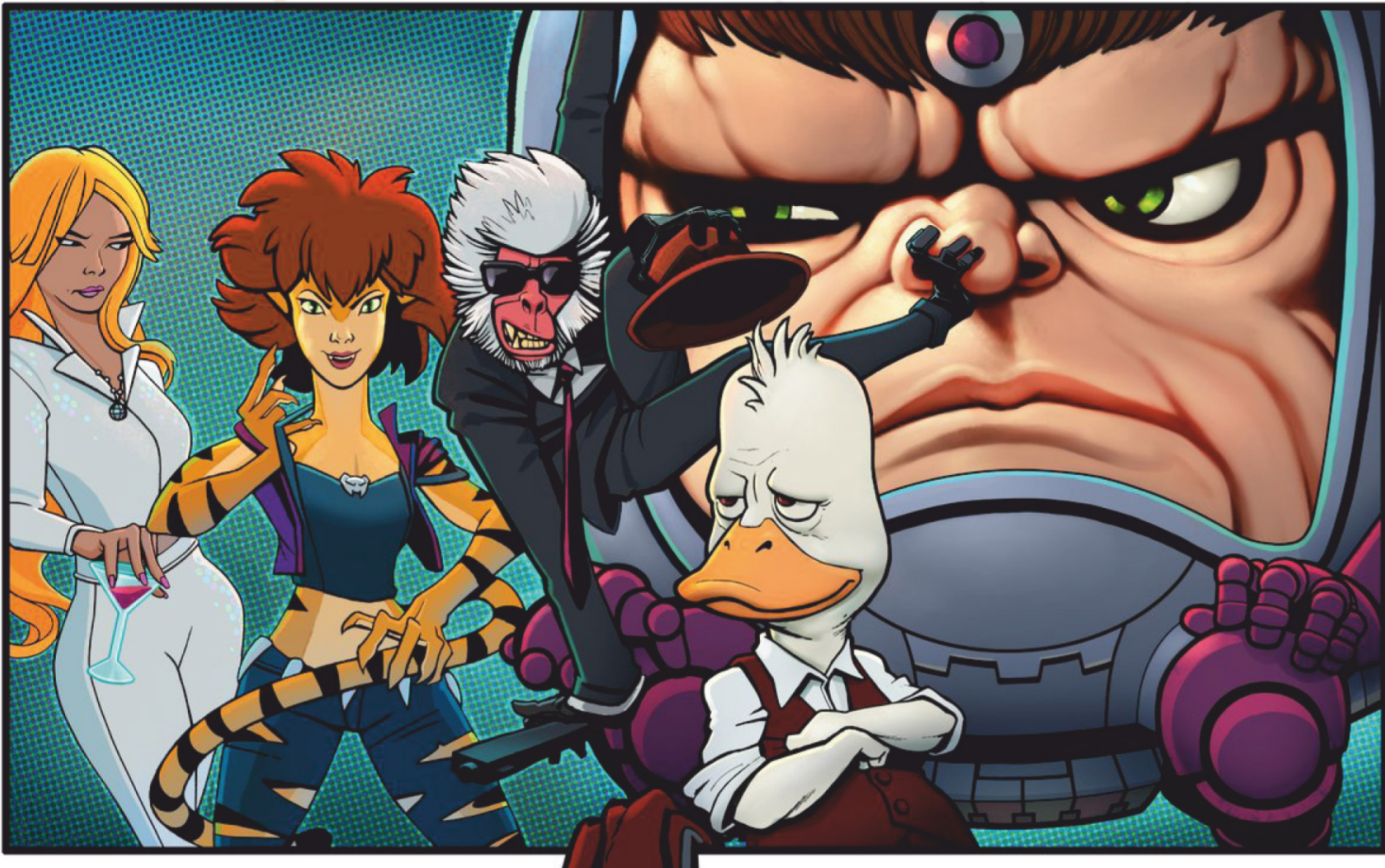


Image source: Marvel

Hulu doesn’t have the original content budgets of Netflix or Amazon (it was around \$2.5 to \$3 billion in 2018, according to analyst estimates). But Springborn said, “As far as spend goes, we are empowered to be as aggressive as we need to be when going after projects and content we’re passionate about.” One example is the \$160 million Hulu spent to license all 180 episodes of *Seinfeld* in 2015.

“There’s nothing we can’t buy if we really want it,” said Springborn.

Disney will reportedly beef up that content budget in the future. The 21st Century Fox acquisition could also be good news for Hulu. Consolidation and layoffs are rumored on the film front; but as for TV and streaming, one of the biggest questions is what Disney will do with FX. Along with HBO, FX is arguably the top quality television network today, with critically acclaimed series such as *Atlanta* and *American Crime Story*—even as the network’s acclaimed showrunner Ryan Murphy jumps ship to Netflix. Disney CEO Bob Iger has said he will invest more in FX, which he described on an earnings call as “an engine that will be able to supply Hulu with a lot of high-quality content.”

The original content race has also finally broken through HBO’s prestige TV bubble. The resignation of longtime chief Richard Plepler marks the end of an era for HBO and the beginning of AT&T’s content stockpiling. HBO plans to release 150 hours of original programming this year, up 50 percent from 2018, amid rumors of layoffs and consolidation under WarnerMedia, AT&T’s new entity combining HBO, Turner, and Warner Bros.

AT&T’s strategy is to pool its assets and invest in more content firepower to take on Netflix, Disney, and the rest of the competitors. New WarnerMedia head Bob Greenblatt has wasted no time coming after Netflix by name, and AT&T CEO Randall Stephenson has suggested potential ideas around short-form content, such as mobile-optimized, 20-minute-or-less episodes, as opposed to HBO’s traditional hour-long dramas and half-hour comedies.

“It’s getting to be a crowded field,” Greenblatt recently told NBC News. “We think there’s room to carve out a very good consumer base for us... We have our



**AT&T’s
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pool its assets
and invest in
more content
firepower to
take on Netflix,
Disney, and
the rest.**



collection of assets, and I think we can put them together in a way that's really compelling and where there's a way to build the subscriber base."

SEARCHING FOR TENTPOLES

Even as HBO is at last subsumed by its new corporate overlord, every streaming platform it's competing against is acquiring rights and investing in big-budget series to try to find the next *Game of Thrones* or *The Walking Dead*.

The traditional definition of a tentpole is a big-budget movie that generates blockbuster earnings large enough to cover a studio's less-profitable movies. In the streaming era, the same basic principle holds true for smash-hit series: They give a network or service a massively popular franchise that not only draws in viewers but also begets prequels, spin-offs, and cross-promoted content opportunities for years to come.

Netflix has thrown every genre and trope against the wall looking for its own GoT or TWD. The closest it's come so far is probably *Stranger Things*, but the service now has a huge stable of popular and lauded shows mixed in with duds and low-budget fare. Hulu found a large audience and critical acclaim with *The Handmaid's Tale* and has a few other big-budget projects in the works.

Prime Video has developed award-winning comedies in *Transparent*, *Mozart in the Jungle*, and *The Marvelous Mrs. Maisel*. But as much as Amazon has spent trying to make *The Man in the High Castle* its cornerstone original, a sprawling drama tentpole has thus far eluded it. Amazon's most resounding hit in terms of viewership may be its adaptation of Tom Clancy's *Jack Ryan*.

Amazon has produced several comedy-awards darlings, including the shows below, but a sprawling drama tentpole series has eluded it so far.



Still, Jeff Bezos is betting a lot on finally obtaining his precious with *The Lord of the Rings*. The company spent \$250 million just for the rights, with projected production and marketing costs reportedly north of \$500 million for the first two seasons and its scripts under lock and key. With the social-media breadcrumbs we've gotten, it seems the creative team will expand the world of Middle Earth with ambitious prequel lore rather than remake the events of Peter Jackson's trilogy. That's smart, both for storytelling reasons and as a long-term engagement play for a fanbase hungry for new content, not remakes.

Alanna Nielsen, Amazon's US SVOD (subscription video on-demand) director for Prime Video, explained Amazon's overarching strategy when it comes to investing in originals, including using viewer engagement and customer behavior data to inform content decisions: The more data and hours of viewing consumers puts into all of these services, the more tailored content Amazon will get back to keep us binging, she said.

"We have a number of ways to get a good read on what will resonate. We have tons of data in terms of what customers are watching, how much of it they're watching, and how long they're staying engaged," said Nielsen. "We also look really closely at customer reviews, a feature Amazon has built on and uses day in and day out to indicate whether we should develop or license more content in a particular area."

LOTR isn't the only big-budget literary adaptation or classic reboot these platforms are developing. Amazon is also investing in a number of science-fiction and high-fantasy series. *Philip K. Dick's Electric Dreams*—a sci-fi anthology competitor with Netflix's *Black Mirror*, was released in 2017, while adaptations of Neal Stephenson's *Snow Crash* and Robert Jordan's *The Wheel of Time* series are in the works.

Netflix has gone the kids' route with such shows as *Lemony Snicket's A Series of Unfortunate Events* and is adapting Roald Dahl's *Charlie and the Chocolate Factory* and *Matilda*, along with *The Chronicles of Narnia* by C. S. Lewis. And HBO has Damon Lindelof's take on *Watchmen* coming this year. Hulu aims to build on the success of *The Handmaid's Tale* with the soon-to-be-released *Catch-22*—and maybe its most high-profile original yet, the *Devil in the White City* series developed by Martin Scorsese and Leonardo DiCaprio.

“We look for projects with overarching themes that are related to today’s world, and we want to tap into those themes and unique, in-depth worlds. We’ve seen success in focusing on areas that have original fandom as well, as book culture does,” said Hulu’s Beatrice Springborn.

Apple’s service isn’t even available yet, but it’s investing in star power and industry clout to make a splash. The company has around two dozen shows in development or production with several very big names, including a reported content deal with Oprah Winfrey and a major bidding war for the rights to new *Peanuts* content.

Apple’s original content includes a morning-news drama with Reese Witherspoon, Jennifer Aniston, and Steve Carell; children’s programming from *Sesame Street* producers; a remake of Steven Spielberg’s *Amazing Stories*; a sci-fi series from *Battlestar Galactica* showrunner Ron Moore; a drama series from *La La Land* director Damien Chazelle; a Sofia Coppola original film starring Bill Murray and Rashida Jones; and projects with Hollywood stars including Chris Evans, Jason Momoa, and Jennifer Garner attached. *Thor: Ragnarok* director Taika Waititi is also adapting Terry Gilliam’s sci-fi/fantasy classic *Time Bandits* as a TV series for Apple.

Disney, on the other hand, doesn’t need to buy rights one at a time. It’s not as dependent on enticing big showrunners and stars, either. The entertainment giant built its tentpoles on massive M&A deals.

Disney bought Marvel Entertainment for \$4 billion in 2009, Lucasfilm for another \$4 billion in 2012, and now 21st Century Fox for \$71.3 billion. It’s no secret how well those acquisitions and the cinematic universes they’ve spawned have worked out on the big screen, and now Disney is extending its cash-cow franchises with streaming exclusives.

**WHAT
MAKES UP
DISNEY+**

Disney

MARVEL

P I X A R

**STAR
WARS**

 **NATIONAL
GEOGRAPHIC**

The massive Disney+ catalog will feature new original Marvel and *Star Wars* series, including a limited series starring Falcon and the Winter Soldier, a Scarlet Witch series starring Elizabeth Olsen, and a Loki series starring Tom Hiddleston. The new season of *Star Wars: The Clone Wars* will also debut on Disney+ along with a Jon Favreau–directed live-action series called *The Mandalorian* with Pedro Pascal and a newly announced *Rogue One* prequel series starring Diego Luna’s Cassian Andor, with a reported budget north of \$100 million.

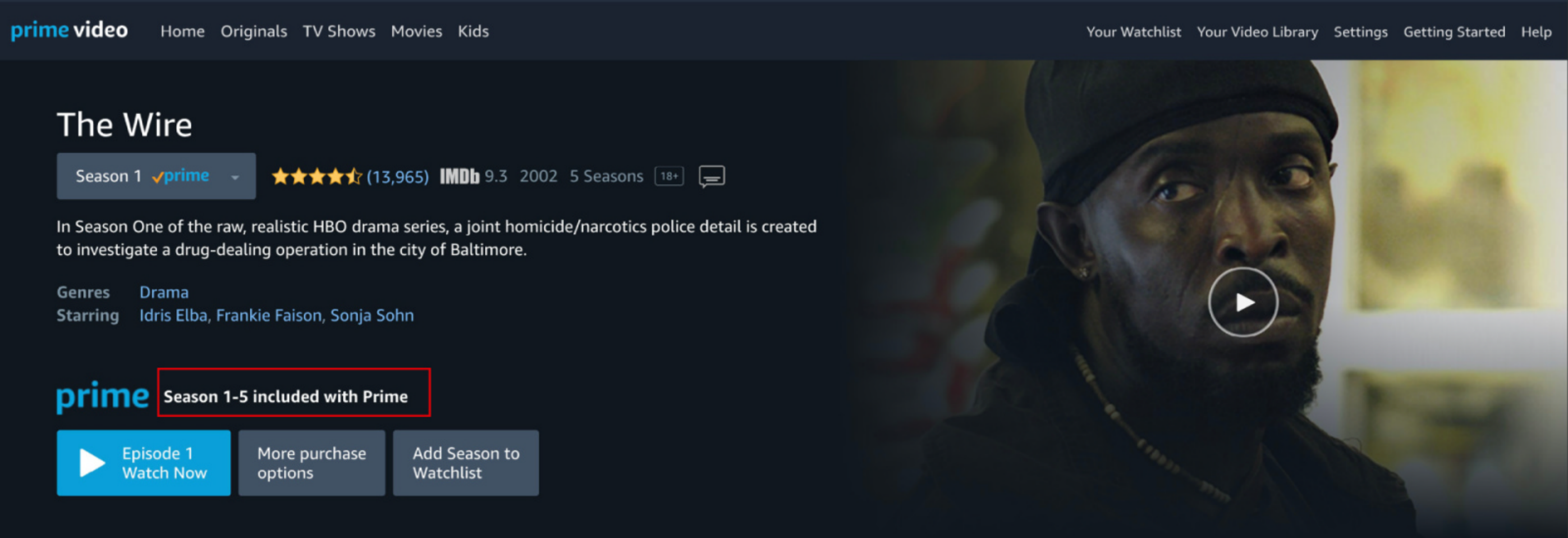
The sheer size of the tech giants and entertainment conglomerates entering the streaming market can make other players look small by comparison. CBS is a large, profitable media company, but for a service like CBS All Access, it doesn’t have the budget to bankroll dozens of expensive series. CBS Interactive President and COO Marc DeBevoise said the company’s content strategy on originals has been to focus on developing two or three tentpoles.

“You need tentpole programming. We want to develop a couple of franchises, not just one series,” said DeBevoise. “We’ve got *The Twilight Zone* and [have] announced greenlighting of [Stephen King’s] *The Stand* limited series. We also have multiple originals coming out of one brand; with Star Trek, we’ve got *Discovery*, the new Picard show at the end of the year, and the [*Star Trek*] *Lower Decks* animated series from the head writer of *Rick and Morty*. It has to be high-quality dramatic or comedy programming that can speak to why the service is premium; why it’s worth paying for.”

WALLED GARDENS OF MEDIA CONGLOMERATES

In the next two years, the streaming landscape will begin to look a lot different. The coming wave of services from Apple, Disney, NBCUniversal, and WarnerMedia will all be on tap for consumers for a monthly fee alongside Netflix, Hulu, Prime Video, and the CBS offerings. In turn, the entertainment value that sets each service apart (unless you’re Amazon and tie streaming video in with a larger membership) is the coveted content one streaming app has that another doesn’t.

Netflix has been preparing for this eventuality for years. It’s part of the reason the company keeps taking on billions in debt to finance its originals, stocking its content library for a time when all the media producers who once licensed to Netflix pull their shows and movies back behind their own paywalls.



Subscribers will still have access to licensed and syndicated content, like being able to watch the entire run of *The Office* on Netflix or *The Americans* on Prime Video, but how much exactly is unclear. HBO, for instance, signed an exclusive licensing deal with Amazon Prime in 2014. You can watch all of the archived movies and shows in HBO’s catalog—like *The Sopranos* and *The Wire*—through Prime Video, though you need to pay for the HBO add-on through Prime to watch currently airing series and specials. Amazon paid HBO several hundred million over the multi-year deal for the privilege. For AT&T, which sees HBO as the headliner for its WarnerMedia streaming service, those kinds of deals won’t make sense in the future.

Comcast still has a 30 percent ownership stake in Hulu, but what if a few years from now, it doesn’t? NBCUniversal CEO Steve Burke told *Variety* that Comcast is in no hurry to sell its Hulu stake even though “Disney would like to buy us out,” but he also mentioned that NBCU-produced programming accounts for approximately 17 percent of Hulu’s total viewership.

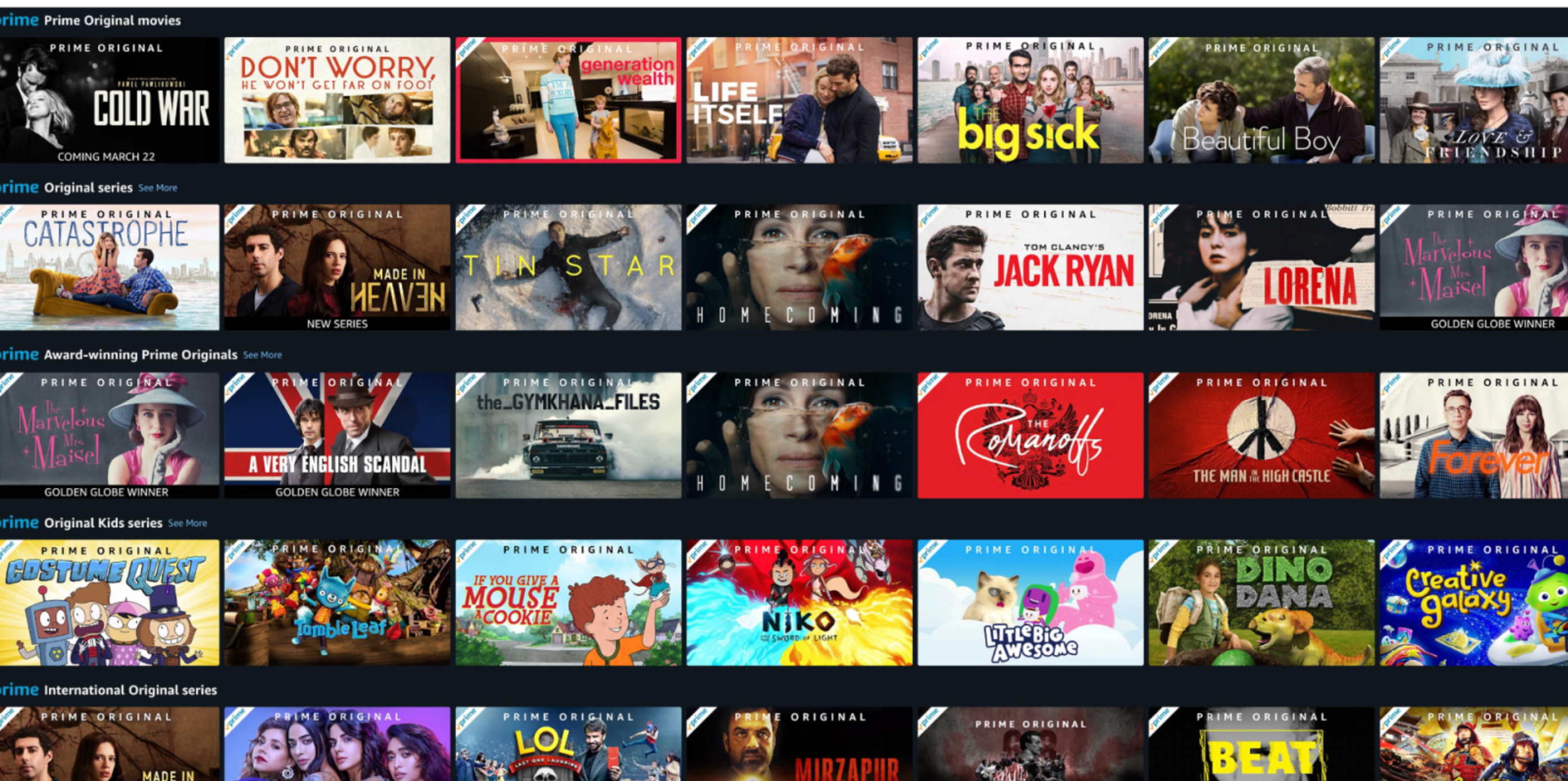
CBS Interactive’s Marc DeBevoise doesn’t see it as a zero-sum game. CBS is perfectly happy to license its content to Netflix, Amazon, Hulu, and others while still keeping a handful of select exclusives for CBS All Access.

“With Netflix, we have no relationship other than selling them licensed content and shows out of our studio. We could see both continuing; depends how much they want to pay,” said DeBevoise. “We don’t have a [CBS Television Studios] show with Amazon, but we license them stuff. We’re in Hulu’s live TV bundle... It’s not ‘we win, you lose’ for us.”

Yet for most of the industry, an inflection point is coming. Looming licensing-deal expirations alongside each company’s exclusive streaming ambitions make

it all the more likely that a few years from now, there'll be a lot less sharing between the old and new entertainment giants.

For now, players such as Amazon—which licenses a ton of content and also offers services including HBO, Showtime, Starz, and CBS All Access as Prime Video “channels”—plan to keep investing heavily in both licensing and originals.



To keep viewers sated in its own walled garden, Amazon is also releasing more shows targeted at specific geographic areas. Nielsen said this means not only greenlighting a lot of international shows but also exploring investments in content developed for different segments and demographics of the US population. She touted Amazon’s programming across dramas, comedies, documentaries, sports, sci-fi and fantasy, and Amazon Original Kids Series.

“We have Prime Originals, we have a very large licensed and syndicated catalog, and I think that we will continue to see an investment on both sides,” said Nielsen. “It’s hard to predict where things will go. There are a lot of players in the market right now, which makes it a really great time to be a customer who loves just being entertained and wants access to a broad variety of video content across multiple services.”



“
**Someone
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best movie.**
”

CONTENT COMPETITION

Netflix, technology companies such as Apple and Amazon, and the big entertainment studios that are launching streaming services have one important commonality: They all use consumer trend data and viewing habits to give us their closest statistical approximation of exactly what we want to buy or watch. But the business of creating that content and the shiny new streaming platforms it lives on is expensive.

CTO of Disney Streaming Services Joe Inzerillo believes that beyond mining data on viewing habits and surfacing contextual recommendations for users, it's ultimately about putting out better content and a better service than everyone else. For a streaming offering to survive, Inzerillo said, it needs “a very compelling set of content, a compelling user interface, and a compelling price.”

“I don't think this is a world where you can be successful with only two out of three,” he said. “Look at the popularity of some of the shows that aren't [Disney's]. There's a show about zombies, a show about dragons and violence...I don't know that a computer sort of spits out that those are good shows. Someone needs to decide this is what customers want. No algorithm is going to tell you how to pick the best movie.”

Jeffrey Cole believes we'll continue to see the streaming market consolidate. Most of the powerful Hollywood studios that long stood on their own are now

owned by \$200 billion media conglomerates. As this market continues to shift, he thinks the next big question is this: What happens when more of the tech giants pushing trillion-dollar valuations enter the mix?

“We’re talking about \$200 billion companies, but the real investments are coming from \$900 [billion] to a trillion; from Apple, Amazon, and Google, not to mention Tencent and Baidu and Alibaba,” said Cole.

If one blockbuster tanks, it doesn’t ruin a studio anymore. Cole pointed to some of Disney’s recent big-budget flops (*John Carter*, *The Lone Ranger*, *A Wrinkle In Time*) as nothing more than rounding errors now, next to the profits of Marvel and Star Wars. They’re immunized against that kind of failure, he said.

Yet as the companies involved keep growing and the competition becomes more fierce over the next several years, Cole believes there’s no cap on which tech and entertainment giants might end up eating another—even giants like Disney and Netflix. He didn’t mind musing over some predictions.

“Disney and Bob Iger are integrating Fox right now and getting Disney+ off the ground. Iger wanted to retire but committed to staying for three years. Apple is sitting on \$275 billion in cash [on hand]...I think when Iger retires, he hands the company over to Apple,” said Cole. “I think Apple and Disney make incredible sense, but Apple could buy either Disney or Netflix in cash. There wouldn’t even be a bulge as they were digesting it.”

THE GREAT REBUNDLING

The consumer’s value quandary in all of this is deciding how many streaming services you’re willing to pay for each month. Are viewers who no longer have a cable contract (or maybe never did) actually getting more entertainment value by choosing a custom bundle of walled-off streaming options than they would get by paying for a cable package with a universal login to access streaming content?

All of these services tout the increasing competition in the market as a good thing for consumer choice—and on some levels, it is. Cable companies had a monopoly over TV for years, leading to decreased incentive to improve their services: Look at the painfully outdated interfaces you still get with a cable box.

But the same companies that lost out in the early days of streaming are catching up. Instead of one streaming service that licenses everything, as in the early days of Netflix and Hulu, consumers are faced with creating what CBS Interactive CEO Jim Lanzone called their “personal bundles.”

“A subscriber to one [streaming service] doesn’t necessarily take away from us, or vice-versa,” Lanzone told PCMag. “Each person has their own personal bundle that will be interesting to them... You spend according to your needs and make those decisions, trading those large [cable] bundles for singular relationships with content providers.”

Gone are the days of paying one \$10.99 monthly subscription for a single collection of hit movies and shows from half a dozen different TV networks and movie studios. Total consumer spending on home entertainment hit a record \$23.3 billion in 2018, up 11.5 percent from 2017, according to The Digital Entertainment Group. A separate analysis from Research Intelligencer found that the average household spent \$285 per month on entertainment last year, up from \$278 in 2017; that’s projected to hit \$295 by 2022. A growing chunk of that is streaming costs.

USC’s Digital Center arrived at a similar number after compiling data from the Internet and Television Association and other sources: \$294 per month in 2018 for communications services that didn’t exist a generation or two ago. That means mobile phones, broadband, television, satellite radio, DVRs, and now, video-streaming technology and music services such as Spotify. For television and streaming content, that breaks down to around \$90 to \$100 per month, Jeffrey Cole said.

The Hulu logo is displayed in a bright green color against a dark background.

**PLANS
START
AT \$5.99**

The Netflix logo is displayed in a bright red color against a dark background.

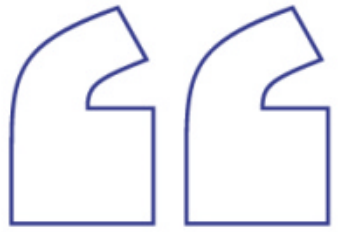
**PLANS
START
AT \$8.99**

The Amazon Prime Video logo is displayed in blue against a dark background, featuring the Amazon smile arrow.

**PLANS
START
AT \$8.99
OR FREE WITH
AMAZON PRIME**

How much of that will consumers devote to their personal streaming bundles? A few years from now, will a household buy separate monthly streaming subscriptions to get the latest originals from Netflix, Hulu, and Amazon; the new Star Wars and Marvel series from Disney+; and the *Game of Thrones* prequels and spin-offs from WarnerMedia's app? Maybe iOS users will decide they'd rather opt just for Apple's service, or maybe Apple and Amazon will decide to outspend or buy up the competition.

Consumers are faced with a nearly infinite amount of content created and stockpiled by companies all betting that their movies and shows are worth a slice of the monthly entertainment budget. Streaming apps offer more choice than ever, but in a market increasingly dominated by tech giants and massive media conglomerates, streaming viewers wistful for the early days of Netflix are out of luck.



Gone are the days of paying one \$10.99 monthly subscription for a single collection of hit movies and shows.



FEATURES

MEET THE BIG PLAYERS

BY ROB MARVIN

CBS

NBCUNIVERSAL

HULU

APPLE

NETFLIX

AMAZON
PRIME VIDEO

WARNERMEDIA

DISNEY+

The streaming-video industry is crowded with big names—some with already-existing services and some with impending apps. Considering the current three largest platforms, the agglomeration of old media companies, and the tech giants investing heavily in video, it can be hard to wrap your head around the sheer scope of this market.

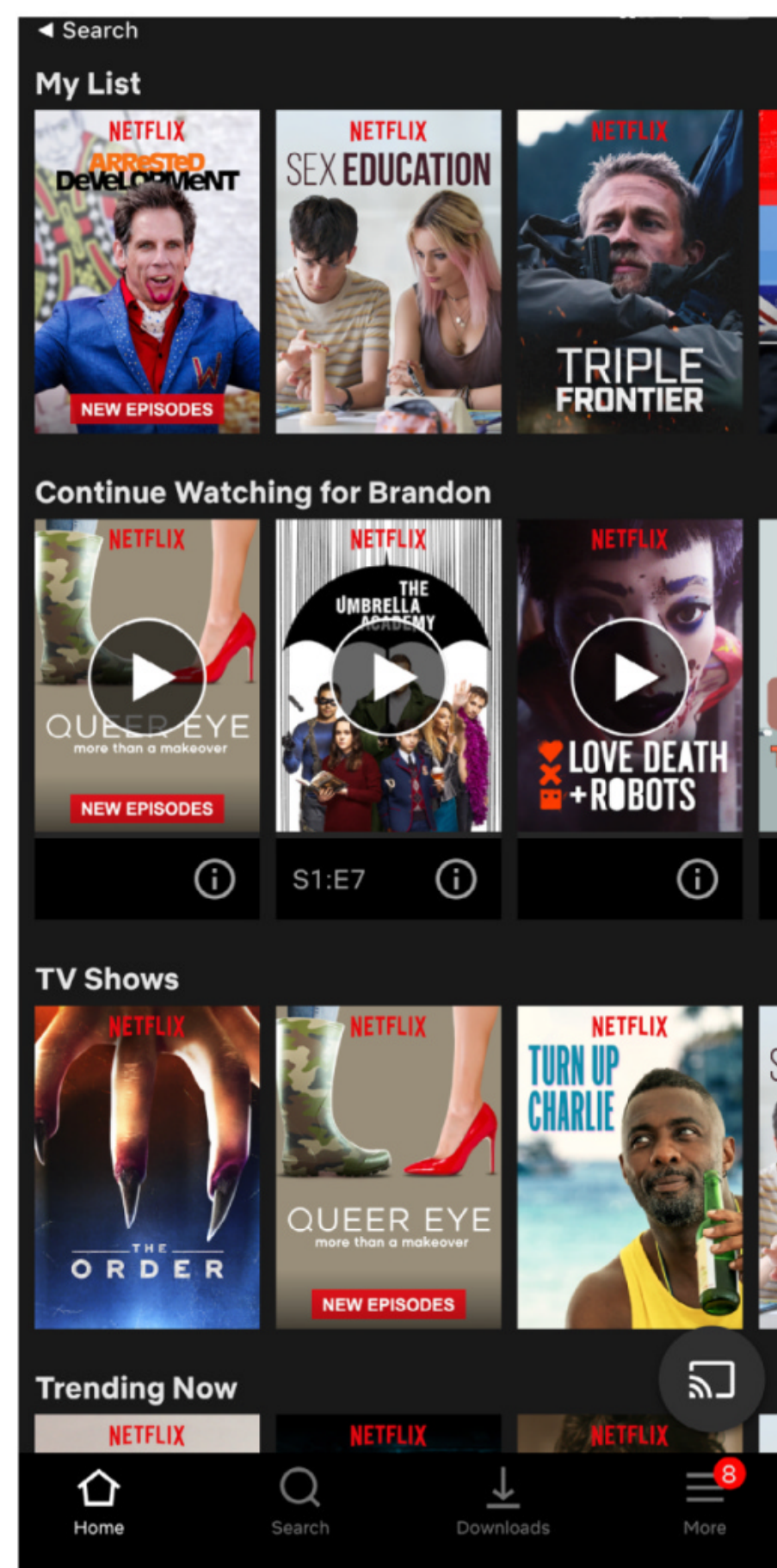
“We’re seeing a ton of fragmentation,” said streaming media expert Dan Rayburn. “NBCUniversal is coming out with a service; Disney, WarnerMedia; Viacom bought PlutoTV; Amazon launched IMDb Freedive; and on and on. Netflix, Hulu, Facebook, YouTube, Amazon Prime, HBO... As consumers, we’re inundated with video everywhere we look.”

Each service has its own origin story, business interests behind it, and assemblage of exclusive originals and licensed content. There’s also a wide assortment of fluctuating prices, packages, and plans. Here are the most important streaming services to watch in the next hyper-competitive phase of this industry.

NETFLIX

The modern streaming industry begins and ends with what many have dubbed the “Netflix Effect”: Despite how many Oscars, Emmys, or Golden Globe Awards the one-time DVD delivery service does or doesn’t win, Netflix’s digital subscription model and its massive investment in originals have set the bar for the market. Netflix reported 58 million US subscribers as of last September and 139 million subscribers worldwide as of its Q4 2018 earnings report.

The company generated \$1.2 billion in annual net profit on \$15.8 billion of revenue in 2018, giving it a current market valuation of around \$154 billion, according to



Bloomberg. Netflix keeps burning cash and raising debt financing to fund its original-content creation, but for now, the strategy is working. The service adds millions more subscribers around the globe each quarter.

Even the most recent price hike across subscription plans isn't expected to dent Netflix's subscriber base much. Jeffrey Cole, a Research Professor at the USC Annenberg School for Communication and Journalism, and Director of USC's Center for the Digital Future, believes Netflix could be charging a lot more.

"It must drive [Netflix founder and CEO] Reed Hastings crazy that a dozen years ago in the red-envelope days, he gave you five DVDs at a time and unlimited streaming for \$16 a month. Now he's giving you not just five theatrical films at a time but dozens or hundreds plus massive amounts of old television shows and \$12 billion worth of originals for \$9 or \$13 or \$16 a month," said Cole, who has researched the TV, media, and streaming industries for close to three decades.

"If you paid \$16 for five DVDs, you should pay \$40 for what you're getting now. But when Netflix broke the company in half, each side priced down at \$8. So Netflix is already handicapped by how much it can charge," added Cole. "How much it can spend on originals depends on how fast it grows, and its growth is international. It will hit a wall...the only question is when."

AMAZON PRIME VIDEO

Amazon, on the other hand, has no discernible caps on how much it can spend, and its business model isn't dependent on video subscribers. Amazon confirmed



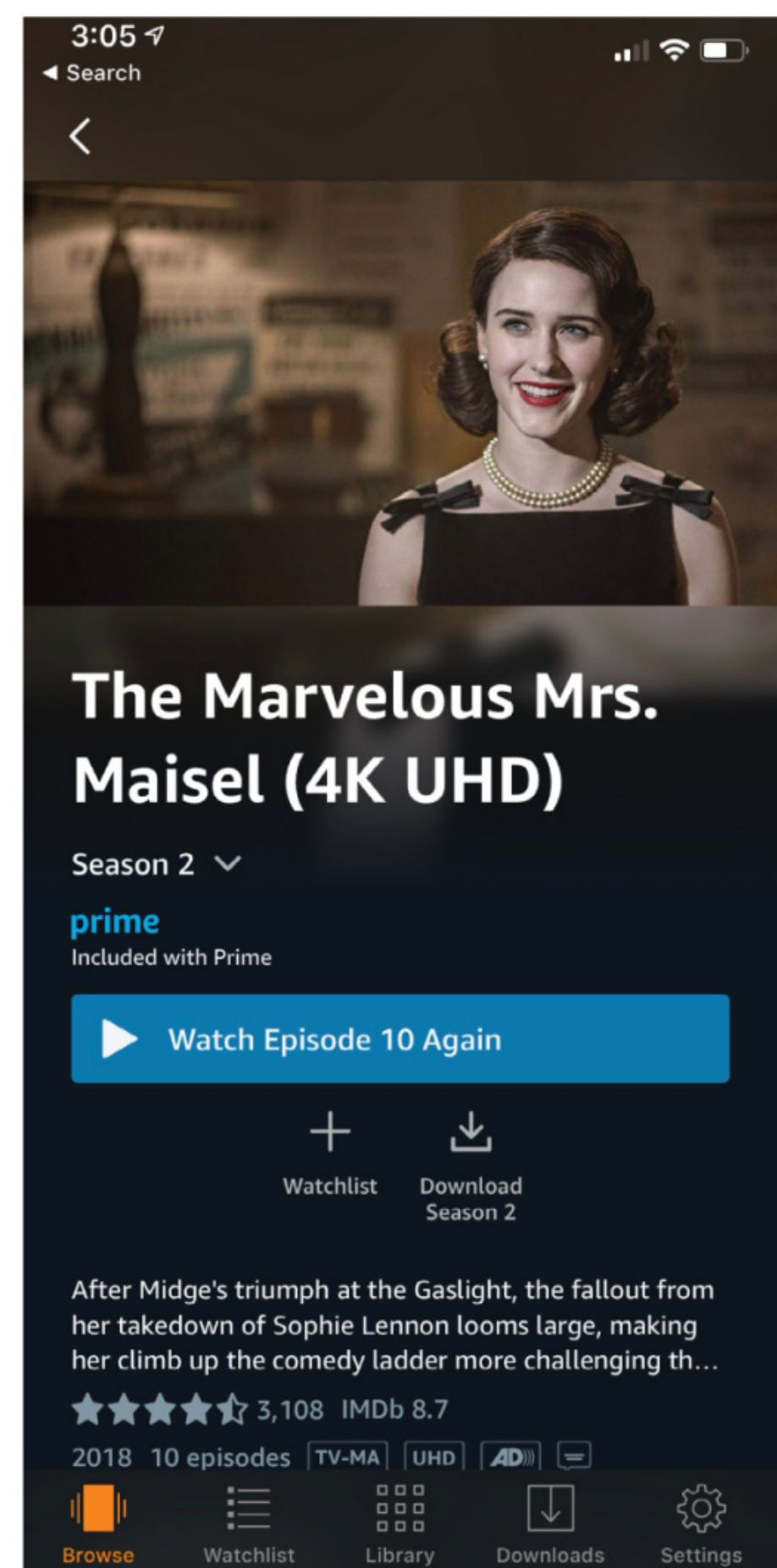
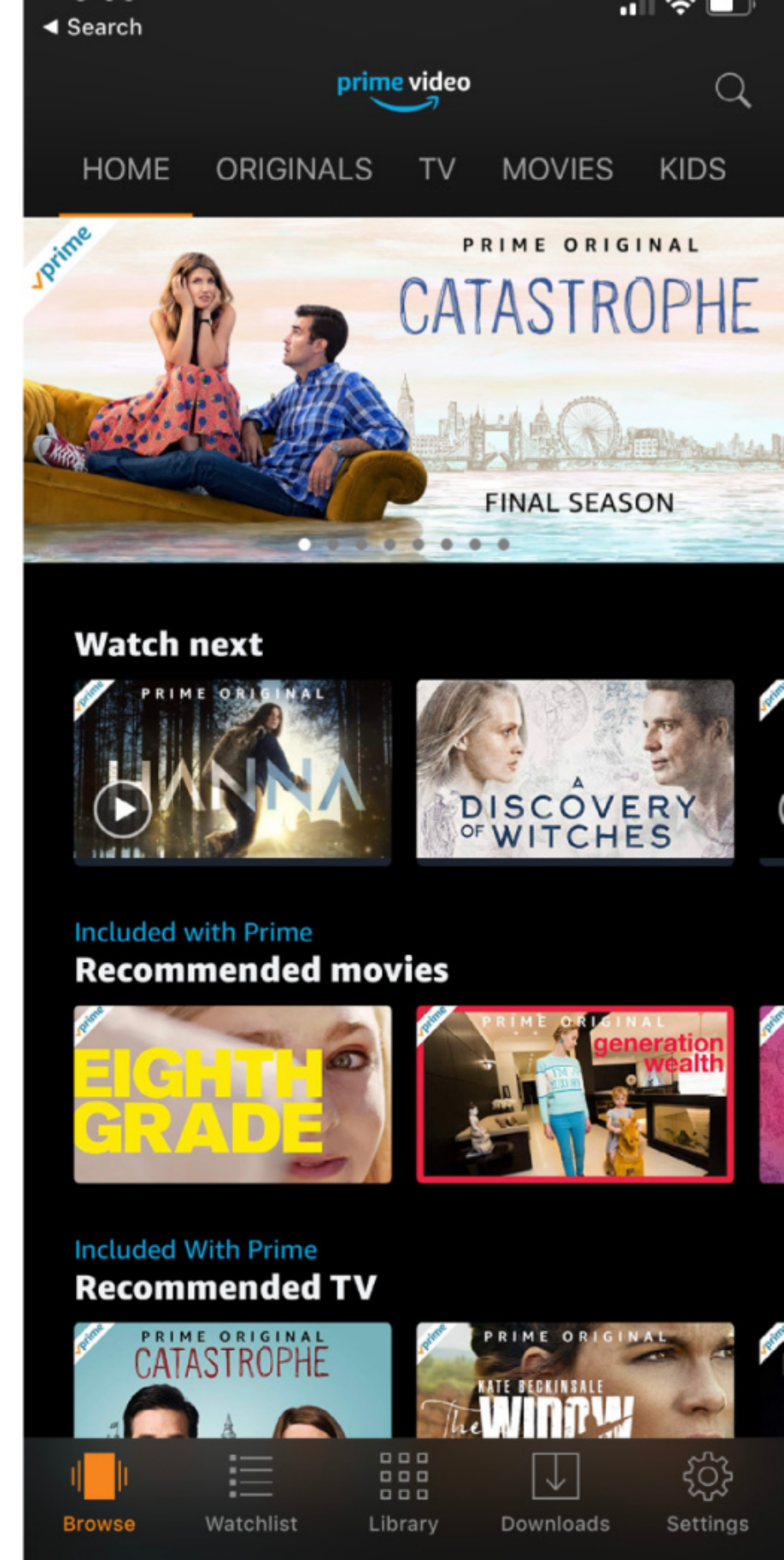
in 2018 that it has more than 100 million Prime members, and Reuters reported that Amazon Prime Video's US audience was around 26 million as of last year.

Prime Video's core value is to drive more Prime subscriptions at \$119 a pop per year—last year, it rose from \$99 in its first price hike since 2014. So Amazon has no qualms about shelling out billions not only for original series, but also to produce and buy up films on the indie festival circuit through Amazon Studios. Standalone Prime Video costs \$8.99 per month.

Amazon also owns Prime Video's underlying infrastructure. Streaming high-quality live and on-demand video requires a complicated content-delivery pipeline, from data hosting and storage to encoding and packaging files, all the way down to content delivery networks (CDNs) and playback. Amazon controls the pipes, and Prime Video can enjoy seemingly infinite scale thanks to Amazon Web Services (AWS).

Other streaming platforms need Amazon's cloud, too. Netflix, for instance, spent years and untold millions building out its own global CDN network (the only streaming provider to do so) but relies entirely on AWS for cloud computing and storage.

“We package up and have built our technology infrastructure on top of AWS,” said Girish Bajaj, vice president of software engineering for Amazon Prime Video. “Because we serve millions of customers and operate this massive amount of scale, it gives both Prime Video and AWS expertise in how to actually operate these systems, and with that level of scale comes cost savings that we then are able to offer back to customers on the consumer side as well as the enterprise side.”





Christopher Fitzgerald
Bobby



Rachel Brosnahan
Miriam 'Midge' Maisel



Alex Borstein
Susie Myerson



29:50 / 29:13 HD

APPLE

Amazon has been competing with Netflix for years, but Apple's high-profile entry into the streaming landscape could further tip the balance of power toward the tech industry. Apple is expected to unveil its streaming platform right around the time this issue closes. It will offer original content as well as a channel-like interface, similar to Prime Video's add-ons, allowing users to sign up for other streaming platforms. Everything will be viewable within the iOS TV app, and iOS and Apple TV users will reportedly get access to Apple's original content for free, at least to start. Apple's originals could ultimately serve as cornerstones for a paid Netflix-like subscription service down the road.

Apple aims to bring an App Store-like gatekeeper approach to controlling streaming content on iOS devices and will take a 30 percent cut on every streaming app subscription through its service. That's a steep commission, but it's in line with the 30 percent it currently takes on premium app and streaming-service subscriptions through the App Store. The commission drops to 15 percent for subscription renewals.

This strategy is part of Apple's broader push into software and services: It has grand designs to expand to several other industries beyond iCloud and Apple Music. Apple, like Amazon, owns its data centers, so every new service it releases holds tantalizing profit margins. *The Wall Street Journal* reported that the tech giant is demanding 50 percent from news publishers for a subscription Apple news service it's building from its acquisition of Texture, described as a "Netflix for magazines." And Cheddar reported that the company is exploring a similar service for video games.

As for original content, Apple's shows will reportedly be family-friendly; no sex, violence, or profanity from Cupertino. When adding yet another online content platform to the digital media pile, banning R-rated content of any kind is certainly one way for Apple to differentiate its originals.

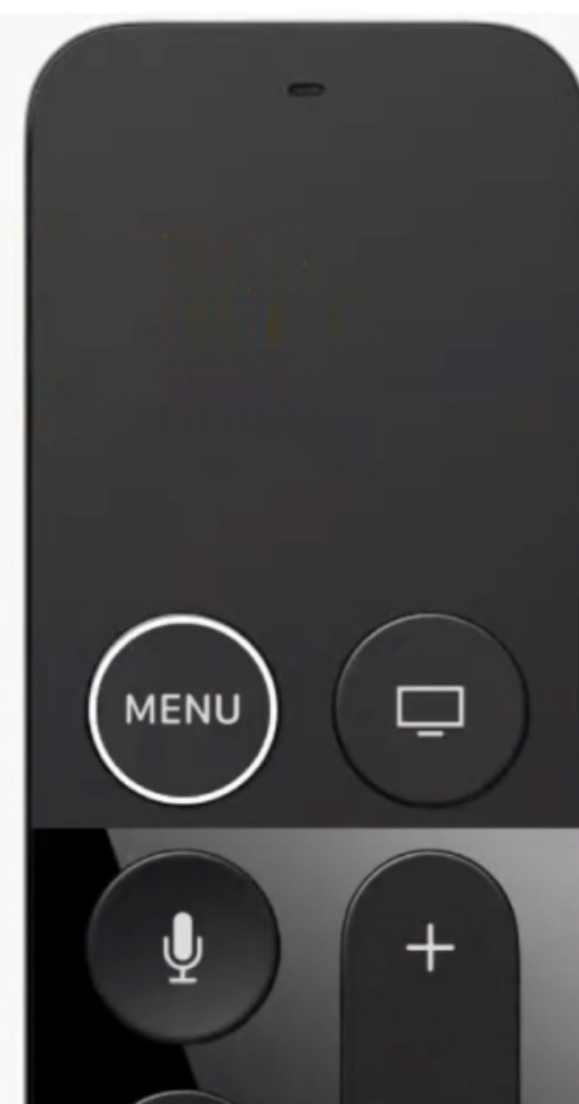
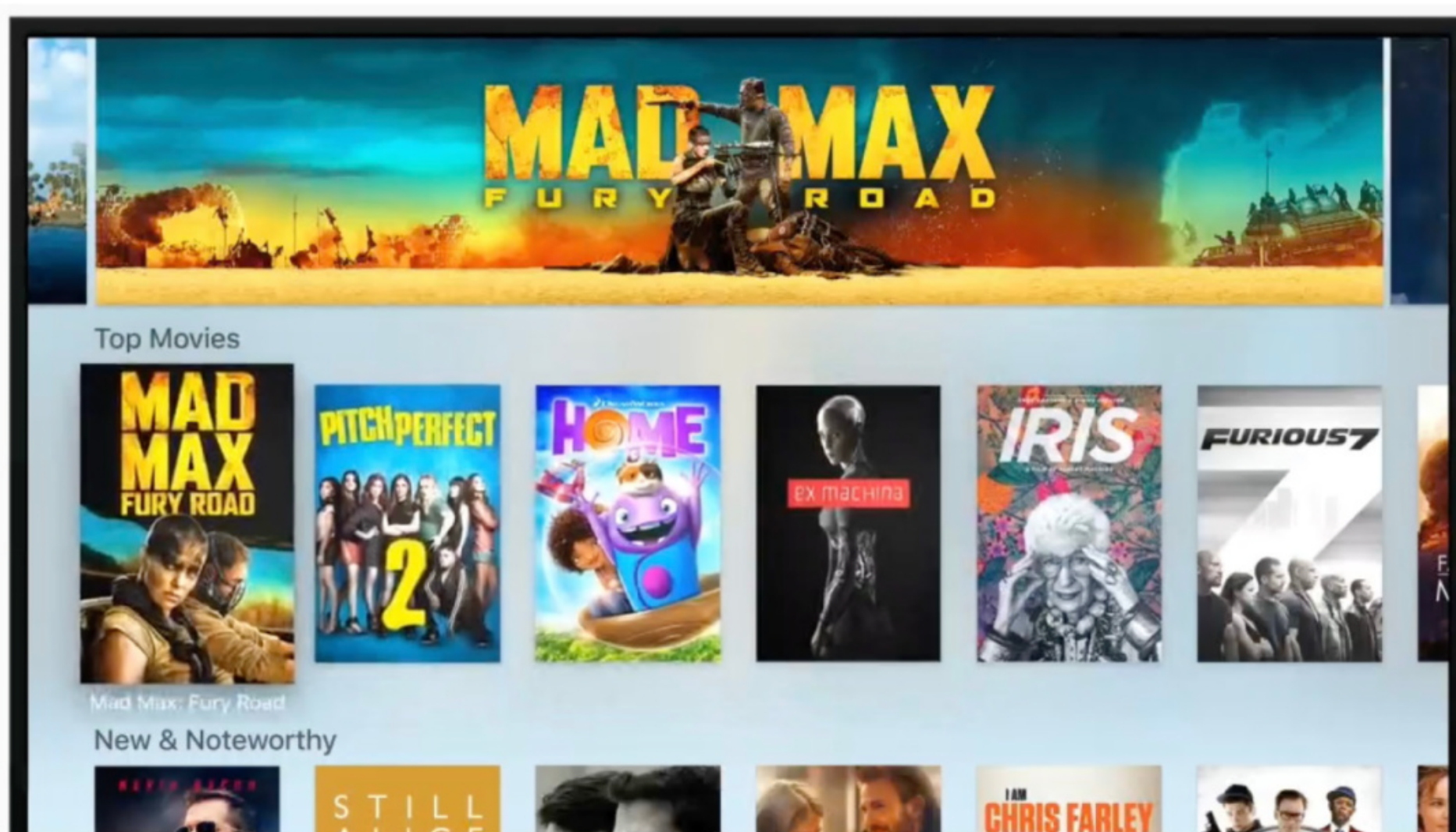
"I think entertainment's going to become a key element of Apple's business," said USC's Jeffrey Cole. "For them, spending \$2 billion on [original content] is just dabbling. If they like what they see, I think they'll have a \$10 billion budget."

HULU

The third established veteran in the market, Hulu is a particularly intriguing player given its new mouse-shaped overlord. Hulu recently announced 25 million total subscribers across its ad-supported, ad-free, and Hulu + Live TV services. The company declined to break down that number into specific subscriber totals in an interview with PCMag.

With Disney's acquisition of 21st Century Fox, the entertainment powerhouse also picked up Fox's 30 percent stake in Hulu, giving it a majority 60 percent (it already owned 30 percent). *Variety* reported that Disney is in negotiations with AT&T to pick up an additional 10 percent stake, leaving Comcast/NBCUniversal's remaining 30 percent as the only outside ownership stake in a streaming platform that has long represented the network TV industry's collective streaming interests. Not anymore.

"Hulu really benefited, I think, by being owned by a handful of studios. Now it's basically a division of Disney," said USC's Cole.



But Cole doesn't believe Comcast will relinquish its Hulu stake for less than a kingly price. He cited Comcast's ultimately failed \$65 million bid to steal 21st Century Fox away from Disney and the open secret of bad blood between Comcast CEO Brian Roberts and Disney chief Bob Iger.

Beatrice Springborn, Vice President of Content Development at Hulu, said the service doesn't measure success by nightly ratings or individual show performance. It's about getting new subscribers to sign up for Hulu, watch a lot of content on the platform, and remain subscribers for the long haul.

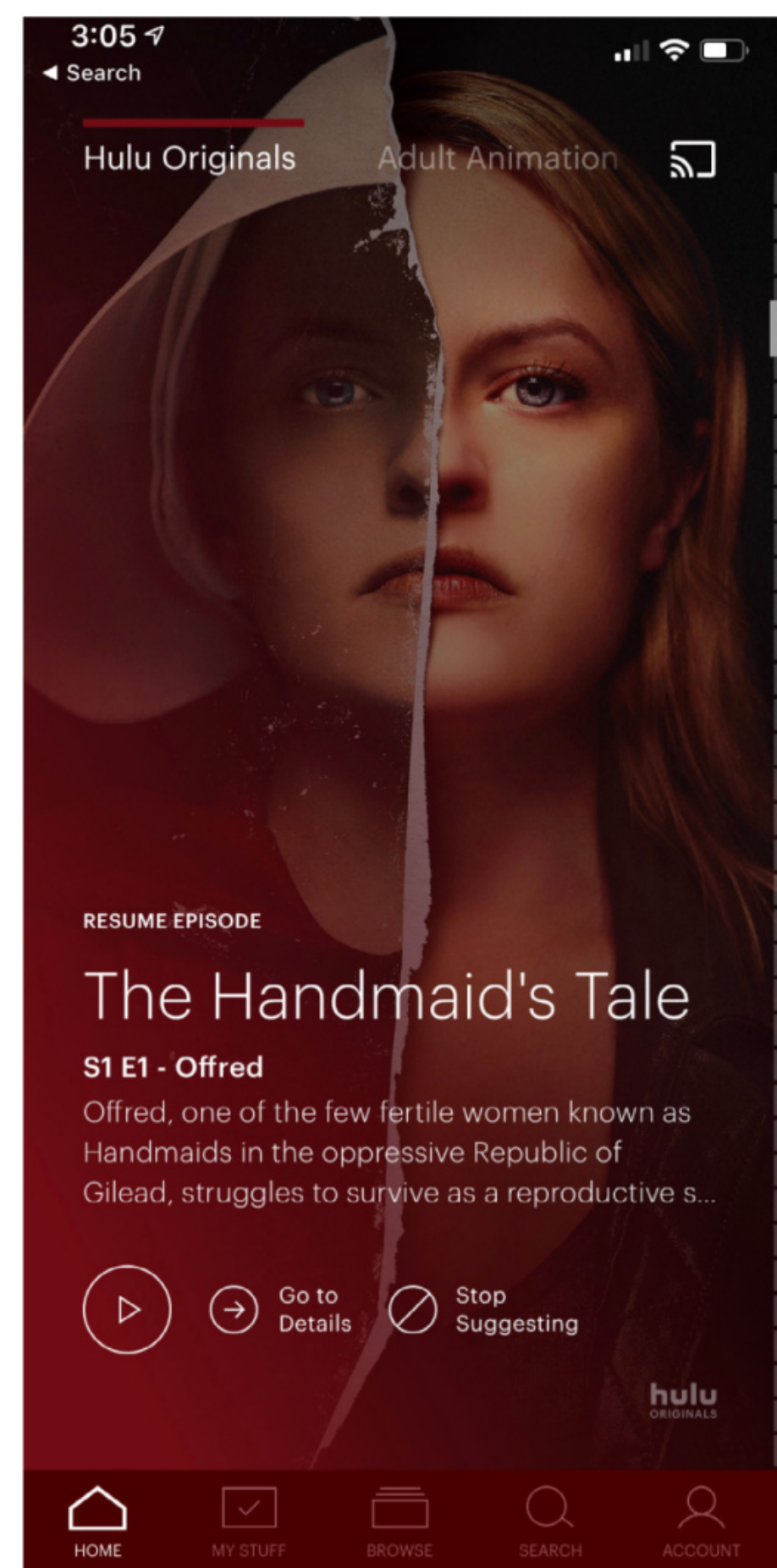
As for how Disney's streaming plans will affect Hulu, Springborn said the company is staying the course until directed otherwise.

"It is impossible to predict the future, but we do know that Hulu is a major strategic asset for all of our owners. Hulu added 8 million subscribers last year, and that kind of growth is only possible when you have owners that support you and are aligned with your strategy," said Springborn. "There is a lot of noise and speculation about transactions right now, but our teams are staying laser-focused on making Hulu the number-one choice for TV."

Following Netflix's price increase across the board, Hulu took the opposite route and cut the price of its entry-level ad-supported plan from \$7.99 to \$5.99 per month. But it did raise the price of its Hulu + Live TV plan package from \$39.99 to \$44.99 per month.

WARNERMEDIA ENTERTAINMENT

Within the corporate consolidation fueling the next wave of services entering this market, the most recent high-profile example is WarnerMedia Entertainment.





WATCHING | HULU ORIGINAL SERIES

The Handmaid's Tale

S1 E1 - Offred



4:48

hulu
ORIGINALS

-52:37

AT&T's newly formed pool of media brands and TV channels centralizes all its Time Warner assets under one streaming roof.

AT&T's major corporate restructuring of WarnerMedia was enacted shortly after the long-awaited regulatory approval of its merger with HBO and Turner parent company Time Warner. (HBO and Turner initially agreed to participate in this story but dropped out shortly before their scheduled interviews, in the wake of the sudden resignations of longtime HBO chief Richard Plepler and Turner head Richard Levy.)

The major changes approved by AT&T exec John Stankey include installing former NBC and Showtime head Bob Greenblatt as the new chairman of WarnerMedia. He will oversee the group's crown jewel—its forthcoming streaming platform combining all the content from HBO, TNT, TBS, TruTV, CNN, the CW, Warner Bros. and DC Comics films, Cartoon Network, and more under a single app.

HBO will still be offered as a standalone service. But all of the premium cable network's original series, movies, documentaries, and so on will also be incorporated into the as-yet-unnamed WarnerMedia streaming service, which is targeted to launch in Q4 2019. We don't know specifics on pricing yet, but Stankey said it'll be more expensive than HBO Now's current cost of \$14.99 per month, which will put AT&T's service at the high end of the price continuum. AT&T CEO Randall Stephenson said on an earnings call that the new service will have a "two-sided business model" with both a premium tier offering commercial-free programming and a more affordable ad-supported tier akin to Hulu.

AT&T's first foray into OTT streaming, DirecTV Now, hasn't enjoyed long-term success. DirecTV Now went with the cable-replication model of bundling channels together into various digital packages, similar to other the Virtual Multichannel Video Programming Distributors (vMVPDs) such as Hulu + Live TV, Sling, PlayStation Vue, FuboTV, and YouTube TV. But as competition has increased, DirecTV Now subscribers have been fleeing in droves: The service lost 267,000 subscribers in Q4 of 2018 alone, and has raised its prices twice in the past year: a \$5 increase last July and another \$10 hike in March.

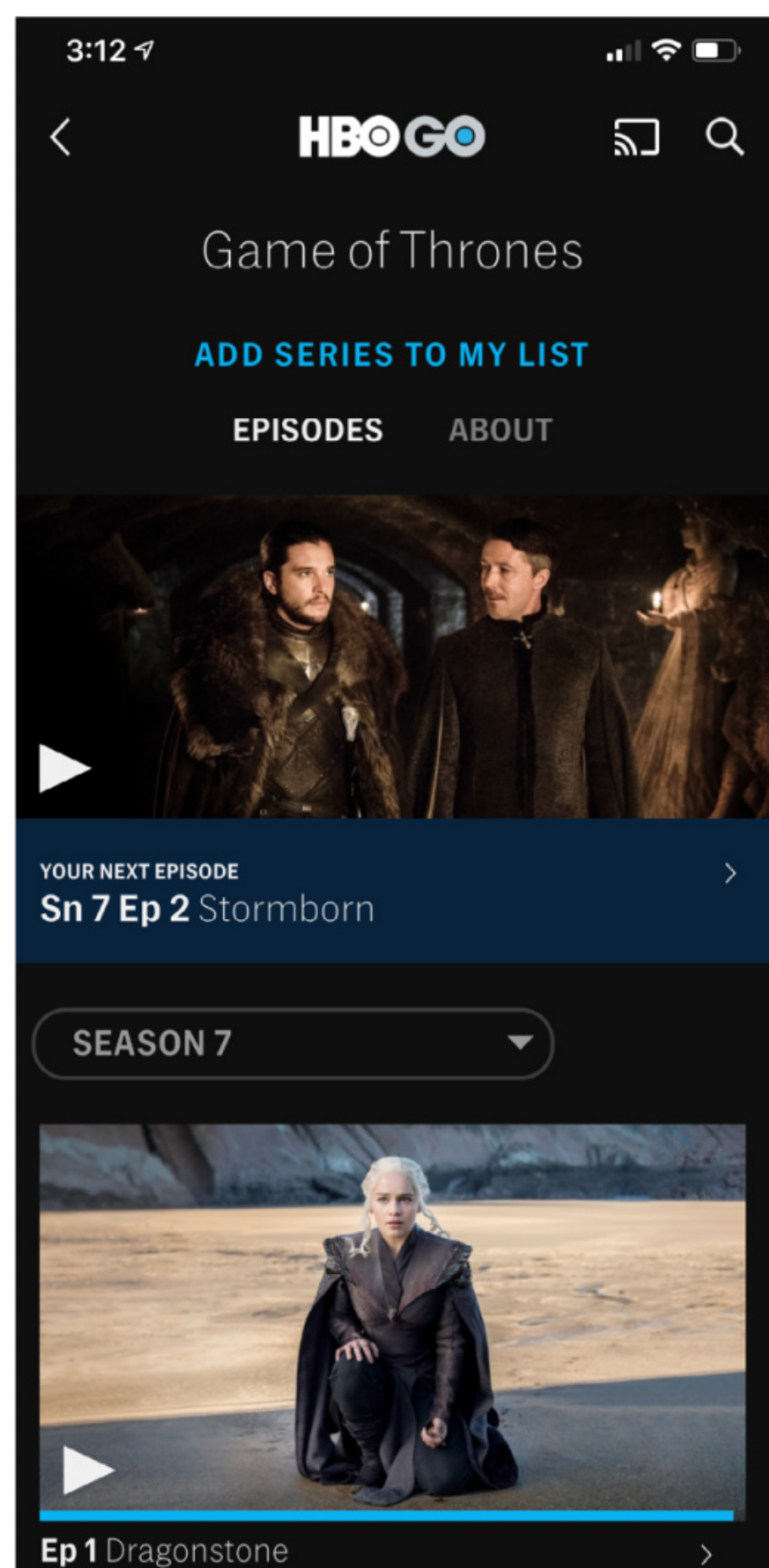
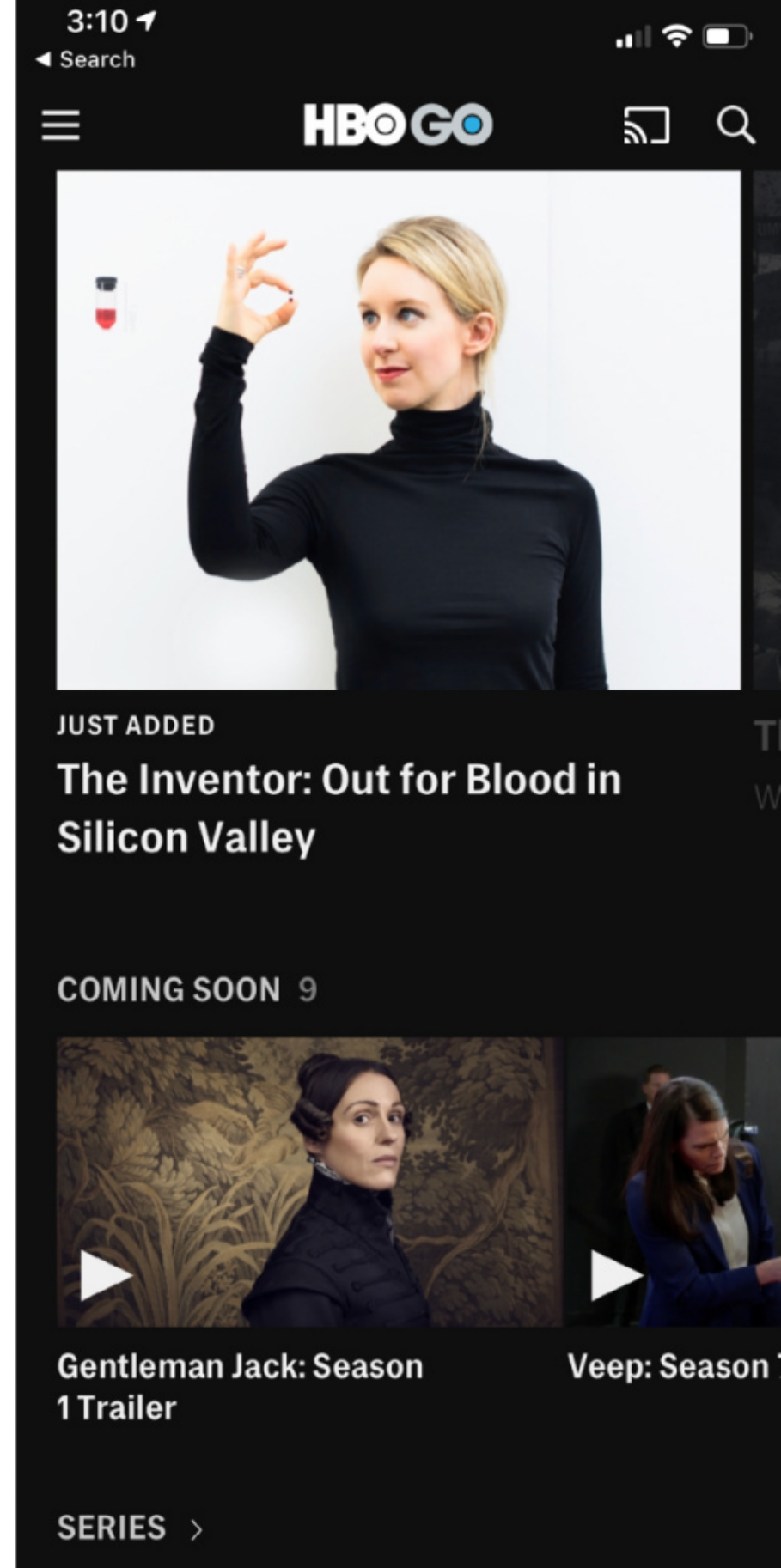
The telecommunications giant's move to buy Time Warner exemplifies a corporate-level shift across the industry away from that costly standalone model.

"We've been talking about cord-cutting for years and the death of cable for a decade, but how many subscribers do these services have?" said Dan Rayburn. "Sling is small. YouTube TV and PS Vue are less than a million each. DirecTV Now is down. That's the reality of this business. None of those services can survive on their own because of the cost of standalone."

NBCUNIVERSAL

Comcast-owned NBCUniversal's streaming service is set to launch in early 2020. There's still much we don't know, but the ad-supported service will reportedly still be free for Comcast and Sky cable subscribers, as current on-demand episodes are on network websites with a cable login. NBCUniversal also hopes to ink deals to offer the service free to subscribers of other cable providers such as Charter, DirecTV, and Dish.

The company will also offer a paid, ad-free version of the streaming service for non-cable subscribers. That



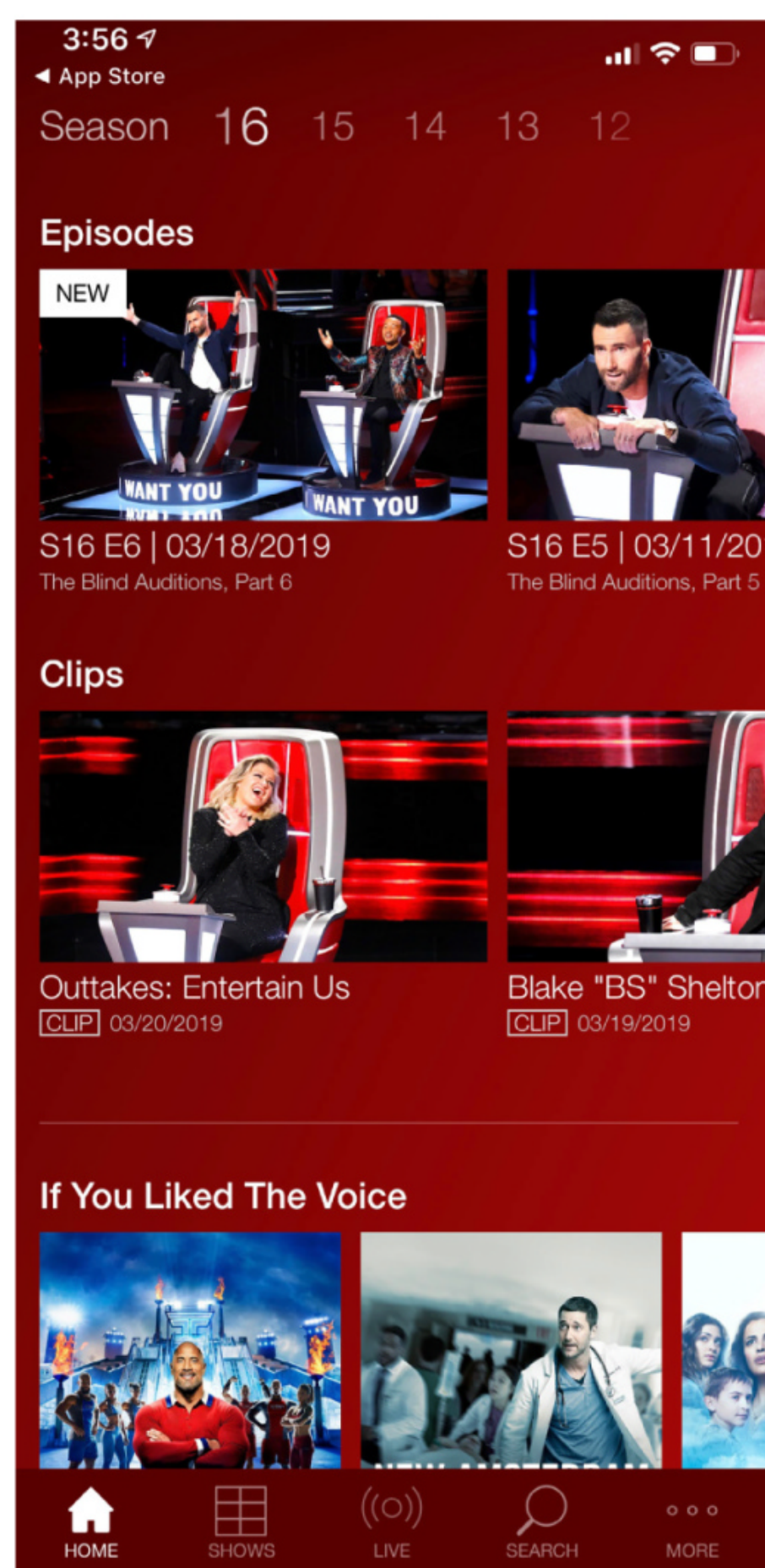
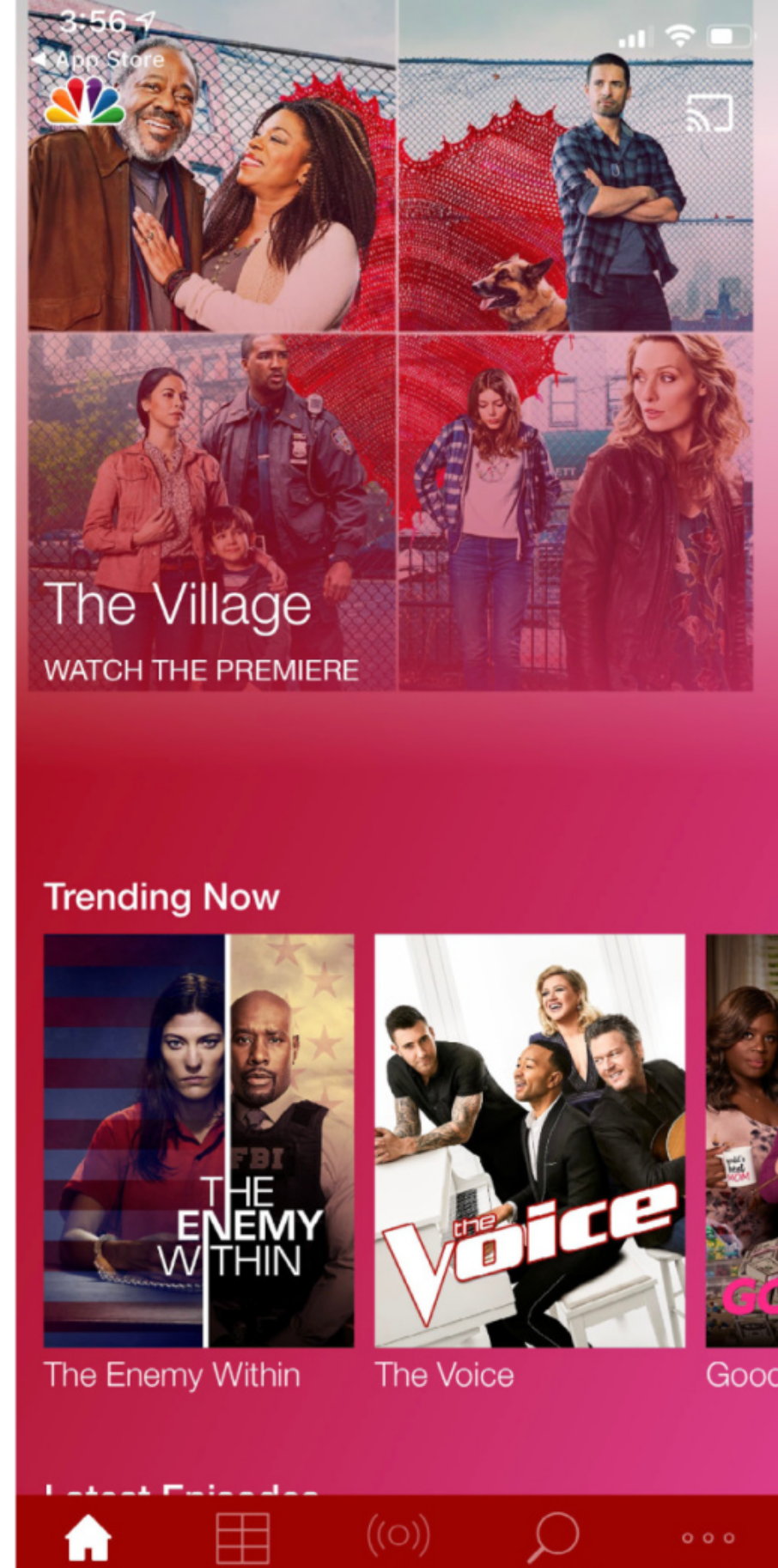
gives NBCU both a subscriber pipeline back to traditional cable and a standalone paid subscription offering to compete in the crowded market for a slice of consumers' monthly entertainment budgets. NBCUniversal CEO Steve Burke said, "We think we can get around \$5 a month from people who would use a free service."

CBS

One media giant that often flies under the radar in the streaming wars is CBS, which owns both Showtime and CBS All Access. The latter has spent a modest original-content budget on a few big franchises, headlined by *Star Trek: Discovery* and additional upcoming Star Trek series; *The Good Wife* spin-off, *The Good Fight*; Jordan Peele's newly debuted reimagining of *The Twilight Zone*; and a coming adaptation of Stephen King's *The Stand*.

CBS All Access is priced at \$5.99 a month with limited commercials or as an ad-free version for \$9.99 a month. Showtime is \$10.99 for the standalone service, but you can also buy or add on the network's Showtime Anytime cable-linked streaming service to existing subscriptions through Prime Video, Amazon Fire TV, Hulu, Roku, Android, or iOS, or through a long list of cable and OTT streaming providers for varying prices.

CBS has been in the digital media and streaming games longer than most, going back to its 2004 deal to buy SportsLine (before CBS and Viacom split) and CBS' subsequent acquisition of CNET for \$1.8 billion in 2008. CBS has built its own streaming infrastructure atop that stack and now has its business firmly planted in all the big buckets: traditional cable and news, live sports, premium cable with Showtime,



and a streaming app in CBS All Access. In its Q4 2018 earnings, CBS reported 8 million total streaming subscribers, including 2.5 million for CBS All Access.

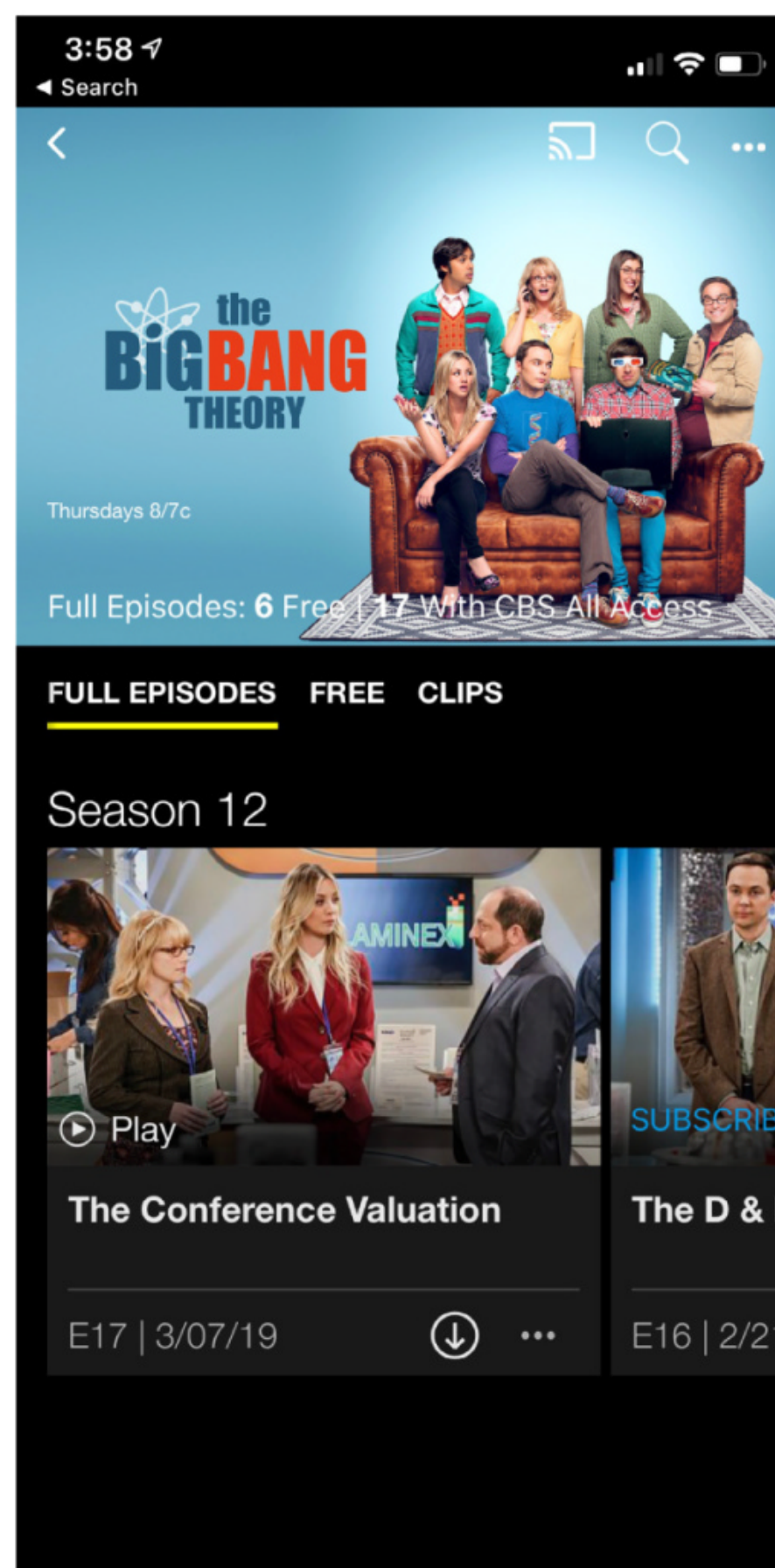
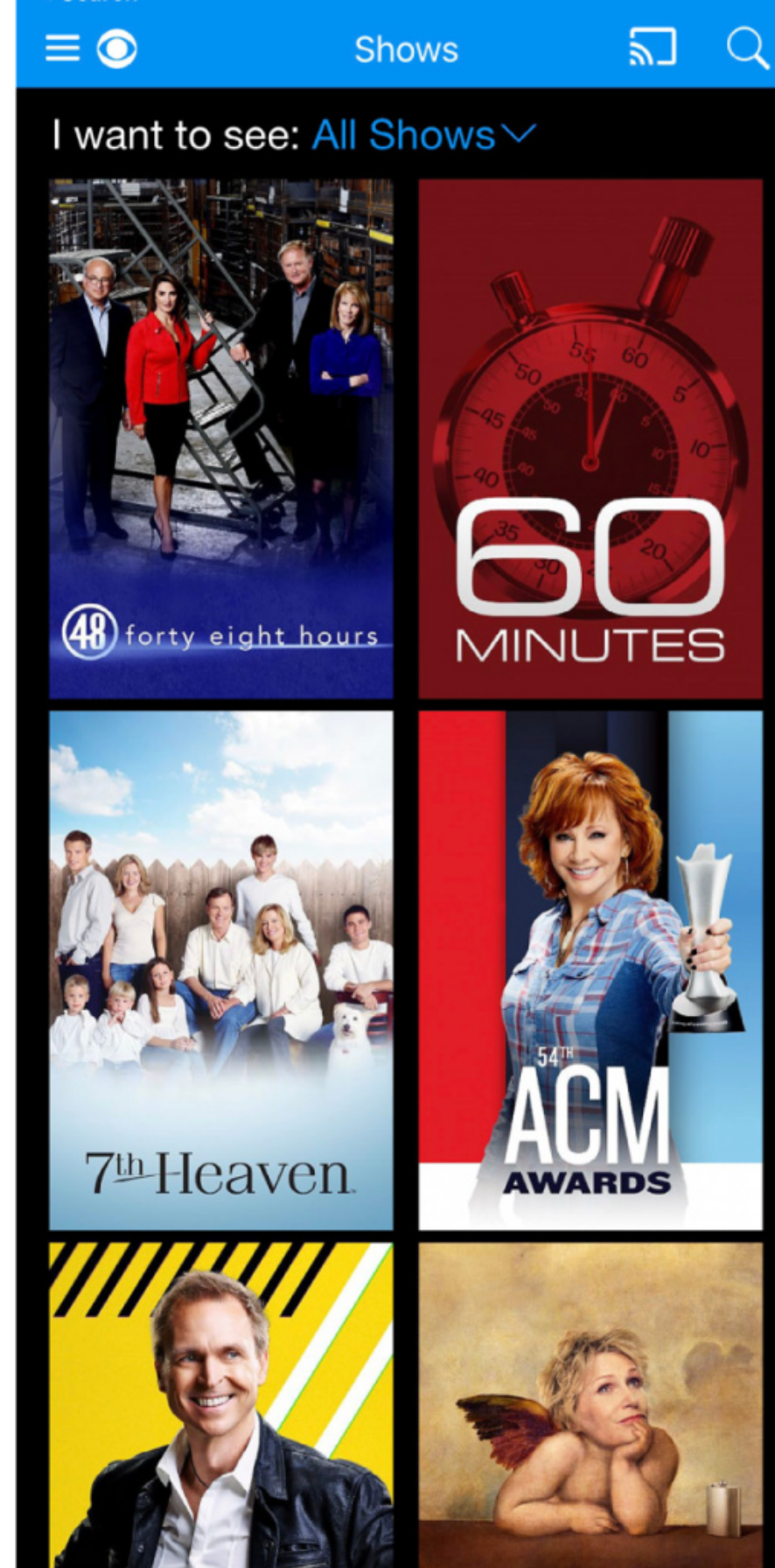
Marc DeBevoise, President and COO of CBS Interactive, spoke to PCMag about the company's choice not to invest in Hulu a decade ago along with Fox, NBC, and ABC/Disney.

“Our greatest gift was not doing the Hulu deal. Because we didn't, we saved our powder. That's where All Access was born,” said DeBevoise. “We felt we could go out and compete, because we had 160 million users in the US across our web properties and reserved libraries of content with over 100 series. By the time 2014-2015 came around, we were ready, whether the content rights were exclusive or not. Then we had the conversation of putting original content on [All Access] to move the needle.”

DISNEY

To get a sense of where the broader entertainment and streaming industry is going for the long term, Disney's strategy may be the model to watch most closely. The company's much-hyped Disney+ streaming service, which is set to launch late this year, will cost less than Netflix—Jeffrey Cole projects somewhere in the \$6-to-\$8 range per month—and offer a small number of big-budget originals on top of the vast library of content already in the Disney vault.

Disney has taken its time making a definitive, calculating, multi-stage entry into the streaming market, going back to 2016, when it invested \$1 billion for a 33 percent stake in BAMTech. Formerly known as MLB Advanced Media (MLBAM), at one time the video-streaming company spun out of Major League Baseball powered streaming apps including MLB.TV, HBO Now,



the NHL and PGA Tour apps, PlayStation Vue, and even the WWE Network streaming app.

BAMTech's outside-consulting focus came to a halt when Disney bought another 42 percent stake to take majority control of BAMTech in 2017, and announced its direct-to-consumer streaming services that would become ESPN+ and Disney+ in the same press release. ESPN+, which costs \$4.99 a month or \$49.99 per year, hit a million subscribers a few months after its launch.

Armed with original Marvel and Star Wars series, the Disney and Pixar film vault, Disney Channel kids programming, and the 21st Century Fox catalog including National Geographic, Disney+ looms large. JPMorgan projects the service will eventually sign up more than 160 million subscribers—compared with Netflix's current 139 million—on the basis of its “unmatched brand recognition, extensive premium content, and unparalleled ecosystem to market the service.”

Big-budget franchises like Marvel and Star Wars are key to Disney's business strategy in all their forms: from Disney book series and toys, to blockbuster films and TV shows, to cruise lines and theme parks such as the massive Star Wars: Galaxy's Edge parks opening in Disneyland and Disney World this summer. Disney's end-to-end pipeline is the most fully realized version of a true content-industrial complex; the one piece missing until now was a streaming subscription service.

As the new players, including Apple, WarnerMedia, and NBCUniversal, have found (or will), building a streaming platform from scratch takes time. Rayburn described BAMTech as “the special forces of our industry. They're the best at what they do, and they've been doing OTT streaming longer than anyone. By the time Disney+ rolls out, it will still have taken them 18 months to build it.”



**Disney has
taken its time
making a
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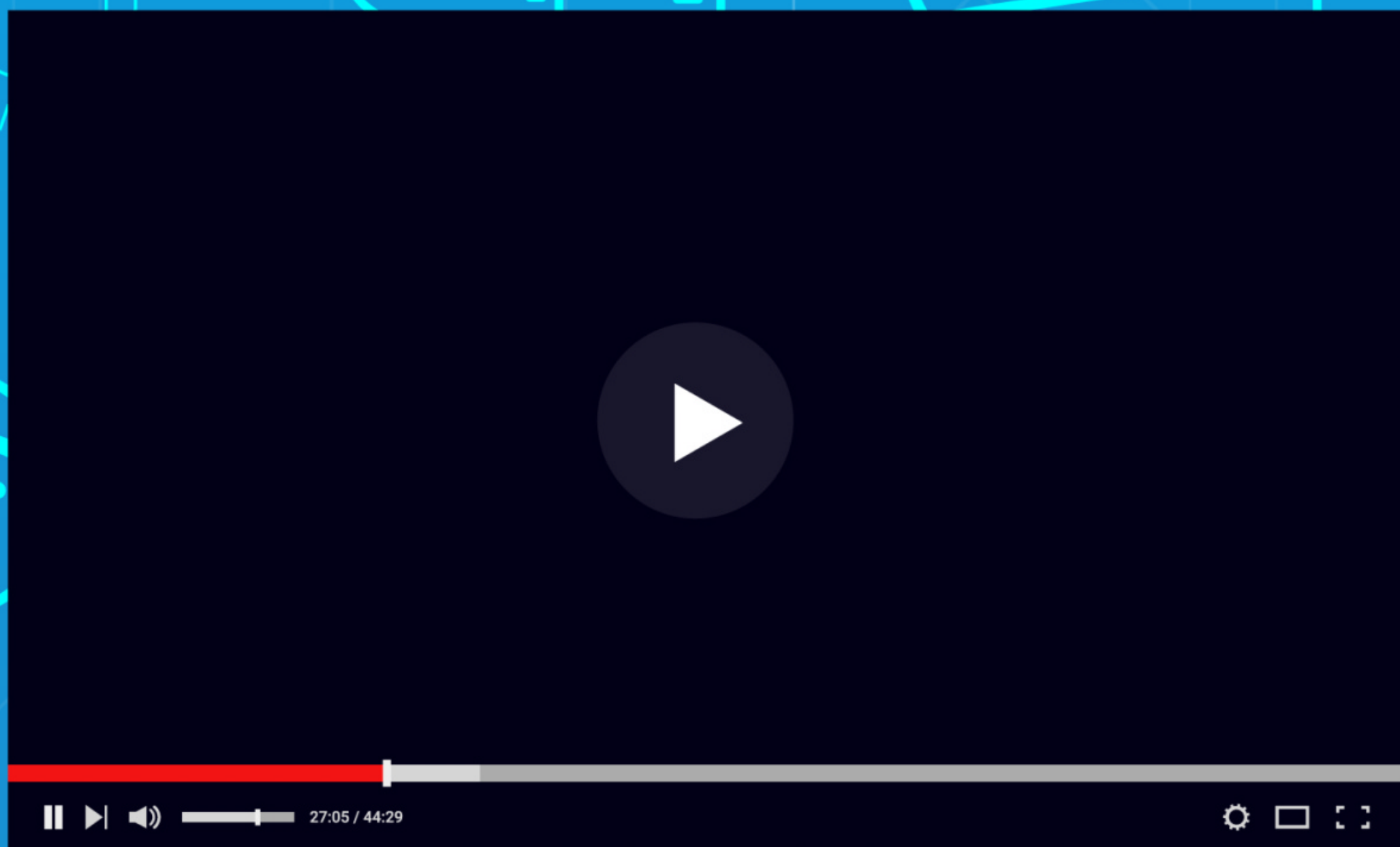


The man building it is Joe Inzerillo, the CTO of Disney Streaming Services. Inzerillo is the former CTO of BAMTech and one of the founders of MLBAM. He oversees all Disney's video-streaming tech, including Disney+ and ESPN+.

While Inzerillo wouldn't comment on any specifics related to the content, original programming, or user interface of Disney+, he hinted to PCMag that Disney is cooking up some fresh storytelling mechanisms to bring its big, interconnected franchises—the Marvel and Star Wars cinematic universes—to viewers in fresh ways.

“The thing I find so incredibly compelling about [Marvel and Star Wars] is that they're [each] one enormous narrative with a bunch of stories around it,” said Inzerillo. “So the user interface of a company's streaming service that makes epic sagas like that needs to be user-connected, and one narrative designed to showcase the content for you and put it in front of the fans that love it, not get in the way. But it also needs to be personalized. It needs to be able to do all sorts of things. So it's the fusion of all those components to create this vision of a constant narrative.”

FEATURES



THE TECH BENEATH THE VIDEO STREAMING WORLD

BY ROB MARVIN

People tend to think of video-streaming giants like Netflix and Hulu as entertainment providers, but they're also vast, global technology companies. Underneath the new season of a show you're bingeing or a live-streamed March Madness game with millions of concurrent viewers is an amalgam of interwoven technology: evolving user interfaces to keep you engaged with the content you're searching for, high-powered backend data operations, and complex streaming-video pipelines to ensure your high-quality stream loads quickly from anywhere in the world, on any device.

Our cover story ("The New Entertainment Giants") breaks down the increasingly competitive video-streaming landscape and how new services rolled out by big tech companies such as Apple and media conglomerates including AT&T, Comcast, and Disney are creating a content-industrial complex for consumers. We spoke to execs from Amazon Prime Video, CBS, Disney, and Hulu, as well as experts and analysts, about the content, technology, and market forces shaping this fast-evolving industry melding the tech and entertainment worlds. This companion story dives into the tech side of streaming.

At the heart of the technical complexity is one simple truth: The internet wasn't built to stream high-quality video to millions of people.

"People talk about the technology as if we just push all the TV over the internet. It's not set up to do that," said streaming media consultant and expert Dan Rayburn. "The internet was not built to deliver video at great quality in large scale; it can't physically handle it."

HOW VIDEO STREAMS OVER THE INTERNET

Netflix, Hulu, Amazon Prime Video, and other veteran streaming players such as CBS have spent years and millions of dollars building out their streaming



People talk about the technology as if we just push all the TV over the internet. It's not set up to do that.



infrastructure to support beaming on-demand content across the internet and the even trickier proposition of streaming live sports and other events. They also have had to figure out how to distribute that video to an increasingly connected landscape of varying devices and screens.



“Just in the last five to 10 years, we’ve gotten into this world with significantly better connectivity between devices, both mobile and in the living room, where you are able to deliver much higher streams to the consumers,” said Rafael Soltanovich, Vice President of Software Development at Hulu. Soltanovich oversees everything from video delivery and metadata to payments and subscriptions.



Streaming isn’t a static medium, like TV. In our on-demand culture, viewers consume content in their own way and on their own time. To get that video to whichever device a user is watching on—a browser on a laptop or desktop, a smartphone or tablet, a media-streaming device, a game console, or a smart TV—that video has to travel through a lot of steps.

Over-the-top (OTT) streaming, or distributing standalone media over the internet, can be a convoluted process to explain. Dan Rayburn breaks it into five steps: video ingestion, transcoding (converting a video from one file format to another), management, delivery, and playback.



“So if a live event is taking place in Atlanta, that signal from Atlanta is the ingestion,” said Rayburn. “Then you encode it to work on the

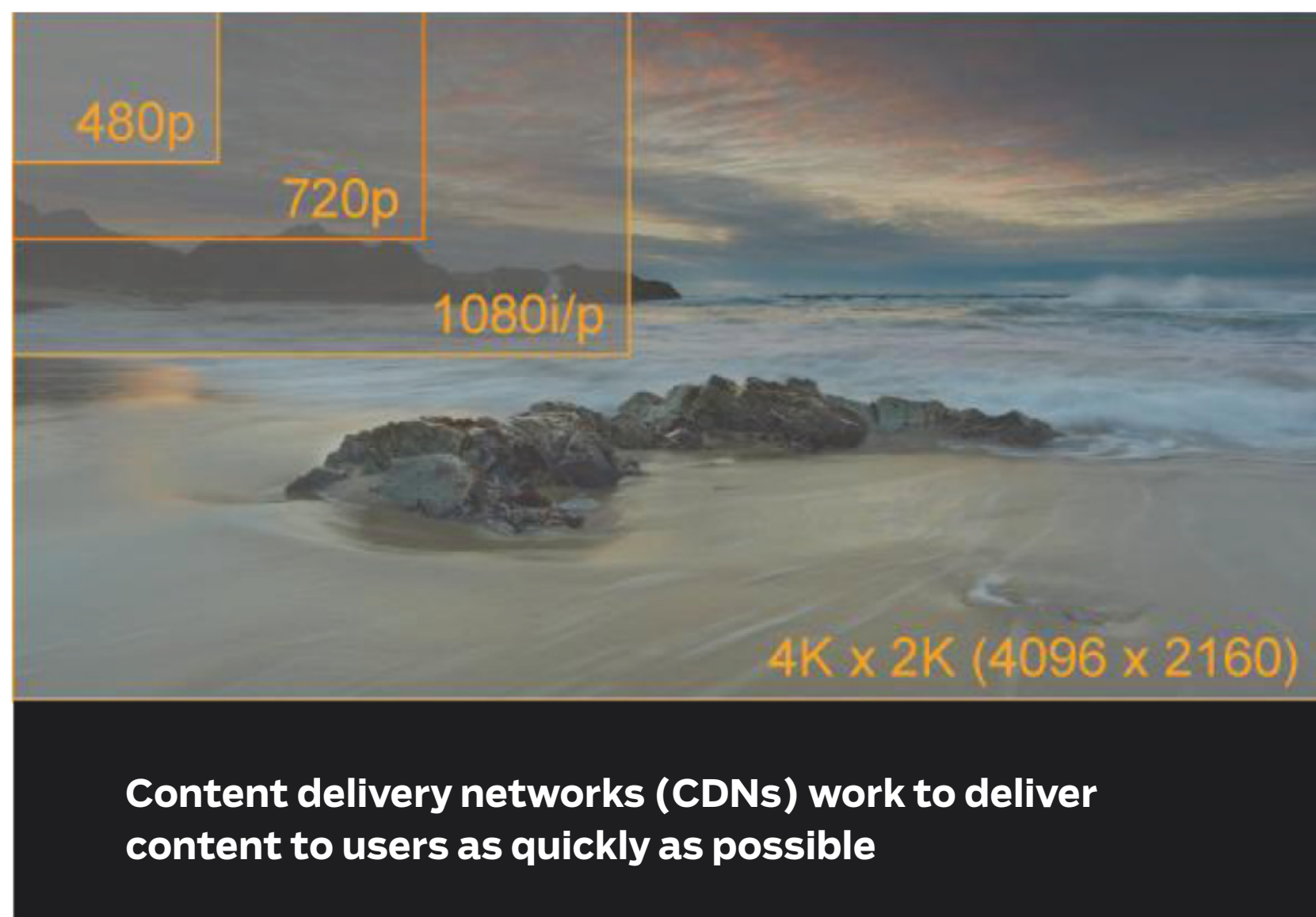
internet; management, which means things like content protection, DRM, dynamic ad insertion if you have an ad model; and then delivery through the internet; and playback on a platform or device.”

In reality , it’s a lot more complicated. There’s no standard for encoding, so video files need to be “wrapped” differently for every platform they’re delivered to; files are wrapped differently for Roku than they are for the PlayStation 4, a desktop browser, a smart TV, or an Android or iOS device. Rayburn said a single video file could be wrapped 20 times or more depending on the devices to which it’s being delivered.

“We have individuals who will be enjoying Hulu on a powerful gaming device: let’s say an Xbox or maybe a PlayStation, or something with far less computational power and memory, such as a streaming stick,” said Soltanovich. “We’ve learned to vary both the size of the [video file] segments and the size of the metadata payload to these devices in order to dynamically adjust, no matter where you’re watching.”

WHAT ARE CDNS?

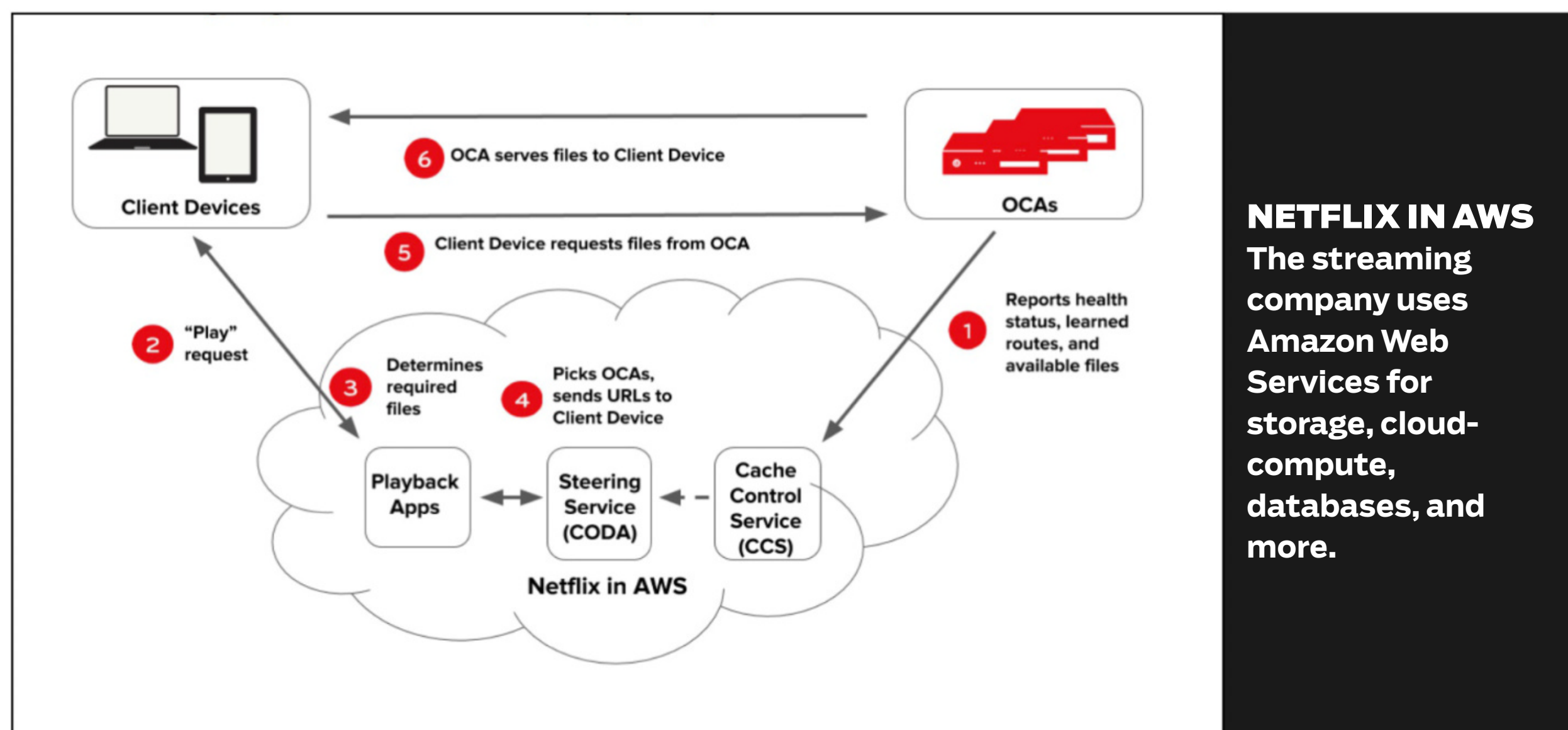
There’s also the matter of delivering HD video at 720, 1080p, or even 4K resolution quickly and reliably to anywhere in the world. That’s where content delivery networks (CDNs) come in, giving streaming platforms a distributed array of data centers and servers to cache and stream content locally to nearby end-users.



Netflix spent years building out Open Connect, its globally distributed CDN, so as not to have to rely on Akamai, Level3, or LimeLight, the three major third-party CDN companies. It’s the only streaming company to do so; Hulu, Amazon, and the rest all use third parties.

Streaming apps also need cloud providers for the rest of the pipeline. Netflix completed a massive cloud migration in 2016 from its data centers to Amazon Web Services (AWS).

“Netflix built out OpenConnect specifically for video; 100 percent of Netflix’s video for the last three and a half years has gone over a network they built out. They were using Akamai before that” said Rayburn. “Netflix doesn’t use Amazon for video delivery at all but still relies on AWS for storage, cloud-compute, databases, and its own transcoding engine built on top of AWS.”



NETFLIX IN AWS
The streaming company uses Amazon Web Services for storage, cloud-compute, databases, and more.

Image source: Netflix

Hulu’s Soltanovich said relying on third-party CDNs has allowed the platform to focus its efforts elsewhere rather than having to build out its own expensive in-house network.

“We’re transferring petabytes of data on a monthly basis,” said Soltanovich. “We’re working with an on-demand library that’s over 85,000 titles. So just the sheer scale, from storage to data connectivity and transfer, makes having a multi-CDN strategy important.

Storing it at our origin and then pushing it out to a number of major CDN providers ultimately allows the quickest delivery, regardless of whether you are in a metropolitan location or on-the-go across the United States,” he added.

For Amazon, having AWS on the back end powering its video streaming makes things easier. Girish Bajaj, Vice President of Software Engineering for Amazon Prime Video, said Amazon employs its global cloud infrastructure combined with machine learning and real-time data processing to dynamically adjust its viewing experience. The goal is to maintain quality using the least amount of bandwidth. Amazon was also the first video service to offer HDR streaming, in 2015.

“Streaming top-quality video over the internet is complex. The closer you get to deploying your infrastructure to customers, the better your availability and performance and quality are going to be,” said Bajaj.

BUILDING STREAMING APPS FROM THE GROUND UP

Creating original content for new streaming services takes time, but so does building the infrastructure to ensure seamless delivery.

Joe Inzerillo, CTO of Disney Streaming Services, talked to PCMag about building the entertainment giant’s Disney+ service, which is scheduled to launch at the end of this year.

Disney+ has been in the works officially since 2017, when Disney took a controlling stake in streaming technology firm BAMTech, for which Inzerillo previously served as CTO. He got his start as the first



Content is still the most important part of the offering, but you can’t monetize it without the product and technology.



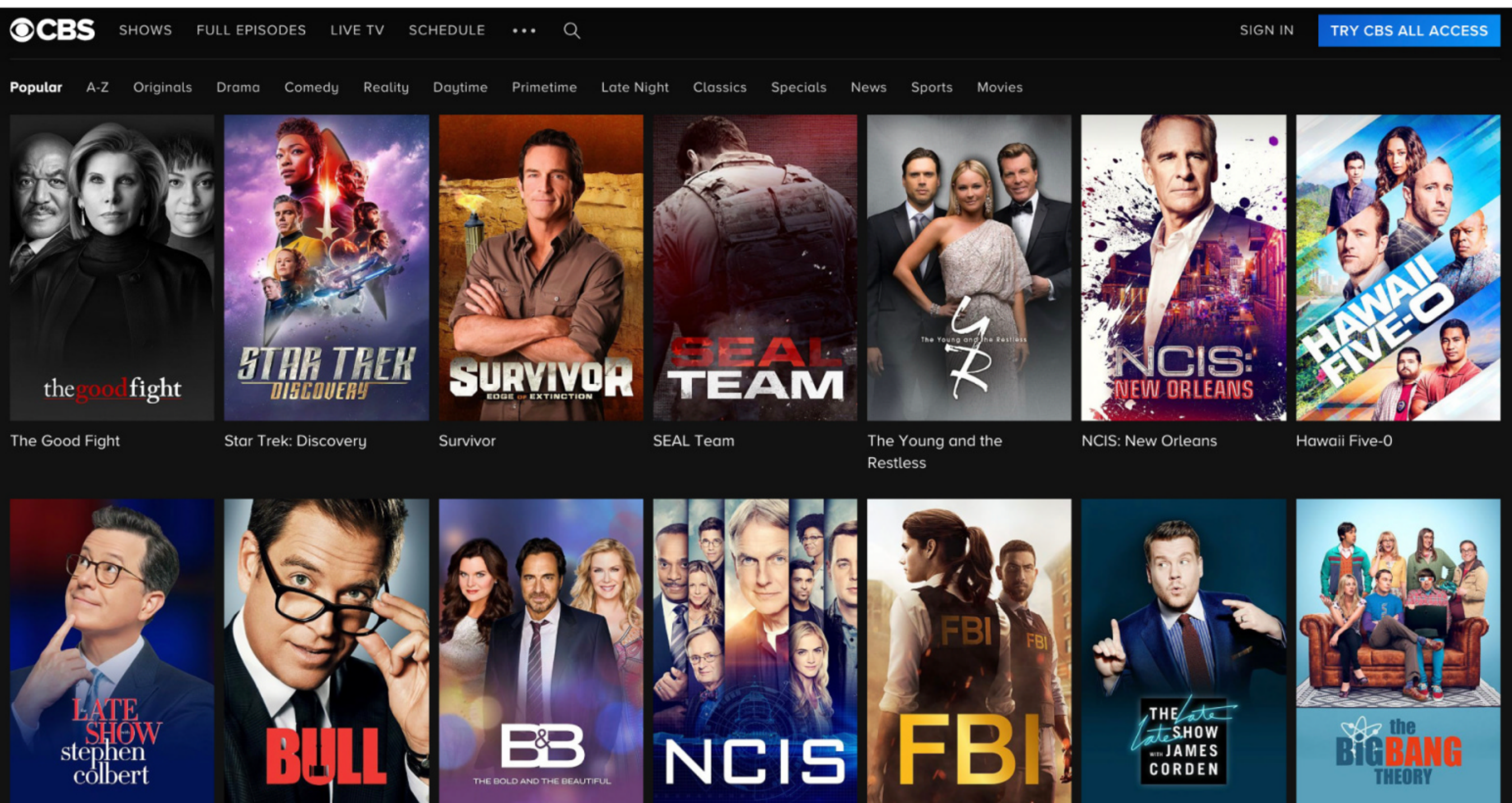
professional video coordinator for Major League Baseball and helped found MLB Advanced Media, which ultimately spun out into BAMTech and now underpins Disney's entire streaming operation.

"We're charged with building basically everything that runs off Disney client-device services; the service layer, video distribution, video encoding, all that stuff—the tactical execution of every Disney streaming product that the world will get to see," said Inzerillo.

More high-profile streaming apps, from WarnerMedia (AT&T's newly formed combination of HBO, Turner, and Warner Bros.) and NBCUniversal, are expected to launch in late 2019 and early 2020, respectively. Just as Apple and Amazon have become entertainment companies, these media companies are also becoming technology providers.

CBS Interactive CEO Jim Lanzone said it's important to think as a multi-platform company. Content is still the most important part of the offering, but you can't monetize it without the product and technology.

CBS built its own streaming infrastructure atop its acquisitions of SportsLine back in 2004 and CNET in 2008. The corporation's video stack now spans live sports, premium cable with Showtime, and a standalone streaming app in CBS All Access, along with its traditional broadcast channel.



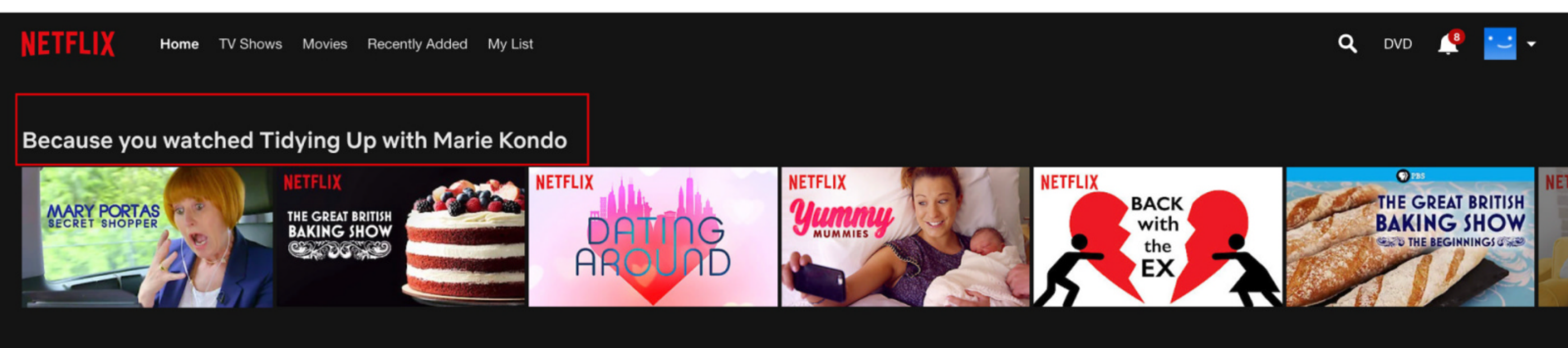
“Think about what the next 10 years will look like for video stacks. Think about machine learning and artificial intelligence, think about it from a content perspective and from an overall data perspective in what that can do for both content and advertising,” said Lanzone. “That technology expertise is becoming a core competency, and it really changes the entire complexion of traditional content companies.”

FIXING BROKEN INTERFACES

One of the most consistent issues for users is how hard it can be to navigate a seemingly infinite selection of content. Even as Netflix, Amazon, Hulu, and the rest invest billions in original content and spend millions to license syndicated shows and movies, viewers are browsing streaming UIs with the same, tired scrolling interfaces that look like digital library shelves.

There’s a fundamental disconnect between the discovery and navigation mechanisms users are given versus the need to develop intuitive UI tools for a new generation of connected entertainment. Streaming companies talk a lot about using artificial intelligence and machine learning to personalize an experience, but those buzzword-laden solutions only go so far.

“These services like using the word ‘personalized’ to describe streaming experiences compared to live TV,” said Dan Rayburn. “Watch a comedy, and you get recommended another comedy; that’s not personalization to me. You can talk all about AI and machine learning, but on TV it’s not hard to just look at a guide and see what’s on.”



I asked several providers how they’re evolving streaming-service UIs. Hulu’s Soltanovich said the platform isn’t just crunching numbers to come up with recommendations; it’s about developing individual user profiles and asking people what they want to see.

He added that you have to ask the right questions and add curated content on top of that. Only then can you start to layer in machine learning to recommend things programmatically, using metadata to surface what users are interested in watching. Netflix and Prime Video also have user profiles to tailor the interface to each user.

“Having that grid of the hundreds of videos that I’ve seen on a number of services is probably not the best way to get to the content anymore,” said Soltanovich. “We need to get to know you as a user. It starts with the onboarding experience we’ve invested very heavily in and our taste picker, which allows you to tailor your preferences and experiences before any major event is coming, such as the Olympics or March Madness...but we still want you as a user to have the ultimate control, to be able to say, ‘You know what? Stop recommending this to me. You actually misread me. That’s not what I’m looking for.’”

CBS also uses a combination of human curation and automation. Marc DeBevoise, President and COO of CBS Interactive, said the company has an AI and machine-learning group building algorithms to target users with specific content. But a lot of the content highlighted on apps such as CBS All Access is manually slotted in, he added.

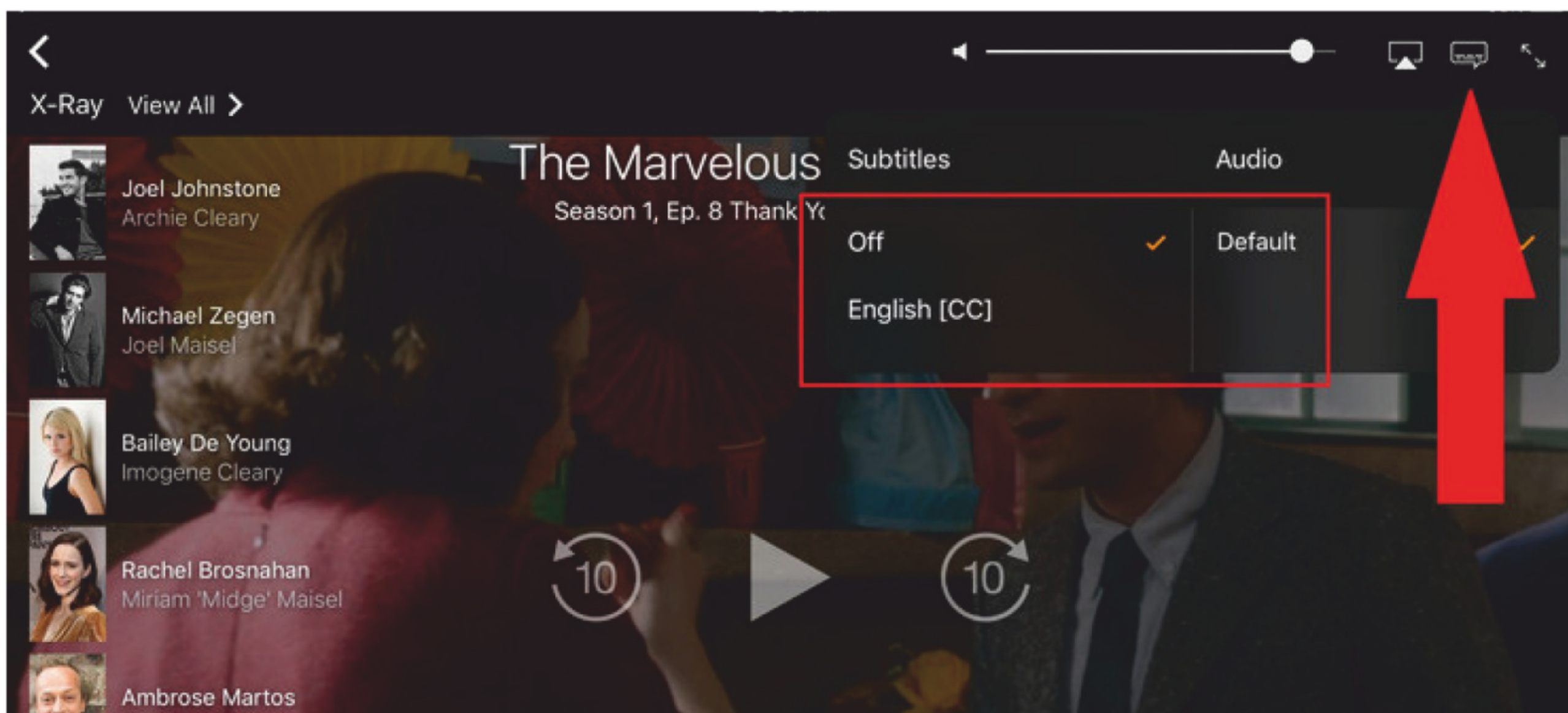
CBS uses automation more in how it markets shows, sending out emails and notifications to users to keep them engaged with new shows based on content preferences. CBS also tweaks its main interface to suit user preferences, DeBevoise said.

“If you click on the shows page, you’ll get the same shows catalog as everyone else. But if you’re in the flow of what is served up in the marquee at the top of the [homepage], sometimes that’s manually curated, and sometimes it’s specific to you,” he said.

Amazon’s user experience approach is a bit different. The actual Prime Video interface is a library-style homepage with tile-based rows of originals, movies, add-on channels, and licensed TV shows. But when you click into a section, you see the same search results page that a product search in the main Amazon e-commerce portal would produce.

Girish Bajaj said Amazon runs hundreds of experiments on its navigation and UI to increase engagement and improve discovery, down to selecting the right images to associate with titles. Amazon also uses machine learning to process vast amounts of customer viewing data and maps behavior patterns to predict what users may want to watch next.

As for improving the UI, Amazon is focused on the viewing experience. Bajaj touted X-Ray, a longstanding feature integrated with (Amazon-owned) IMDb that surfaces actor information in any given scene. This process used to be crowdsourced, but over time Amazon automated it with computer vision to scan every face for an IMDb match. The company has invested more in IMDb lately, even rolling out a free, ad-supported IMDb streaming service called FreeDive.



Recently, Prime Video has also experimented with creating additional behind-the-scenes X-Ray content to augment the viewing experience. And the platform launched X-Ray for sports, offering on-screen, play-by-play updates, live stats, and player information. It was available in Amazon's Thursday Night Football live-streamed broadcasts this past season and is also live for NBA League Pass games streamed through Prime Video.

“We have X-Ray on tens of thousands of titles in our catalog and growing, and now we’re not only aggregating from IMDb but working with creators to produce our own X-Ray content,” said Bajaj. “For example, with *Jack Ryan* and *Man in the High Castle*, we filmed interviews and roundtables with cast members to get inside into those characters and story development, and we offered those videos and those clips to customers at no charge.”

WE’RE GOING LIVE

Live events add complexity to the streaming process—along with the potential for disaster. The more viewers expected to view a stream, the more it costs streaming platforms to prepare for all those users hitting the service at once.

In the heyday of broadcast TV, tens of millions of viewers would tune into the top-rated sitcoms. More than 105 million viewers watched the *M*A*S*H* finale, over 76 million watched the final episode of *Seinfeld*, and almost 66 million tuned into the finale of *Friends*. Sports are still the biggest draw on television; more than 100 million viewers watch the Super Bowl each year.

TV broadcasts have never had to worry about the scale of concurrent viewers watching a show or sporting event affecting the quality of the broadcast. CBS broadcasts its channel, and whether one person or 5 million people watch, there’s no additional cost to CBS.

“The internet is the exact opposite,” said Dan Rayburn. “The moment you have more people, you have more cost. The way live events work on the internet is that companies pay an RSVP fee on the back end, guessing how many subscribers they expect to hit their CDN network simultaneously. Once you estimate the total terabits of capacity, you pre-serve that with CDNs and pay for it even if you don’t use it.”

As more streaming platforms start broadcasting live sports, including NFL and NBA games, the March Madness tournament, and the 2020 Tokyo Olympics, the number of viewers logging onto the same stream at the same time will push the boundaries of what live streaming can handle. And the scale isn’t even close to traditional TV. The most popular live-streamed sporting events, including the Super Bowl, attract between 1 and 3 million viewers. The CBS live stream of the most recent Super Bowl averaged 2.6 million viewers at any given time and peaked at 3.1 million concurrent streams.

At that scale, some streaming providers prepare for months. Hulu streamed the Super Bowl on its live TV service and prepared by doing extensive load testing, beefing up its systems to quickly scale, putting failsafes and redundancies in place in case of disaster, and running war-game simulations for worst-case scenarios. (For some markets, Hulu's 2018 Super Bowl stream cut out close to the end of the game. The company didn't want a repeat this year.)



“When the Super Bowl starts or when overtime starts, millions of people will hit a specific endpoint on your service in an instant,” said Soltanovich. “You need to be able to anticipate when that demand is going to hit and then scale very quickly. The cloud was invented to provide the type of elasticity we’re talking about, but it doesn’t come for free. You can read about all kinds of fancy technology, like auto-scaling, but you need to build up that additional caching and capacity before the users actually click.”

In his MLB Advanced Media days, Disney’s Joe Inzerillo likened trying to deliver flawless live video simultaneously to millions of people to trying to live on Mercury: “The planet is completely inhospitable. Every day all you’re doing is [fighting] a battle for survival in a place that really does not want you. Streaming video on the internet is sort of like that,” he told The Verge in 2015.

I asked Inzerillo about that quote, and he said it still holds up. He’s grappled with this catch-22 for years: The more successful a product is—in his current role, that might be a stream on the WatchESPN cable subscription app or the standalone ESPN+ app—and the more concurrent viewers watching, the tougher it is to maintain quality.

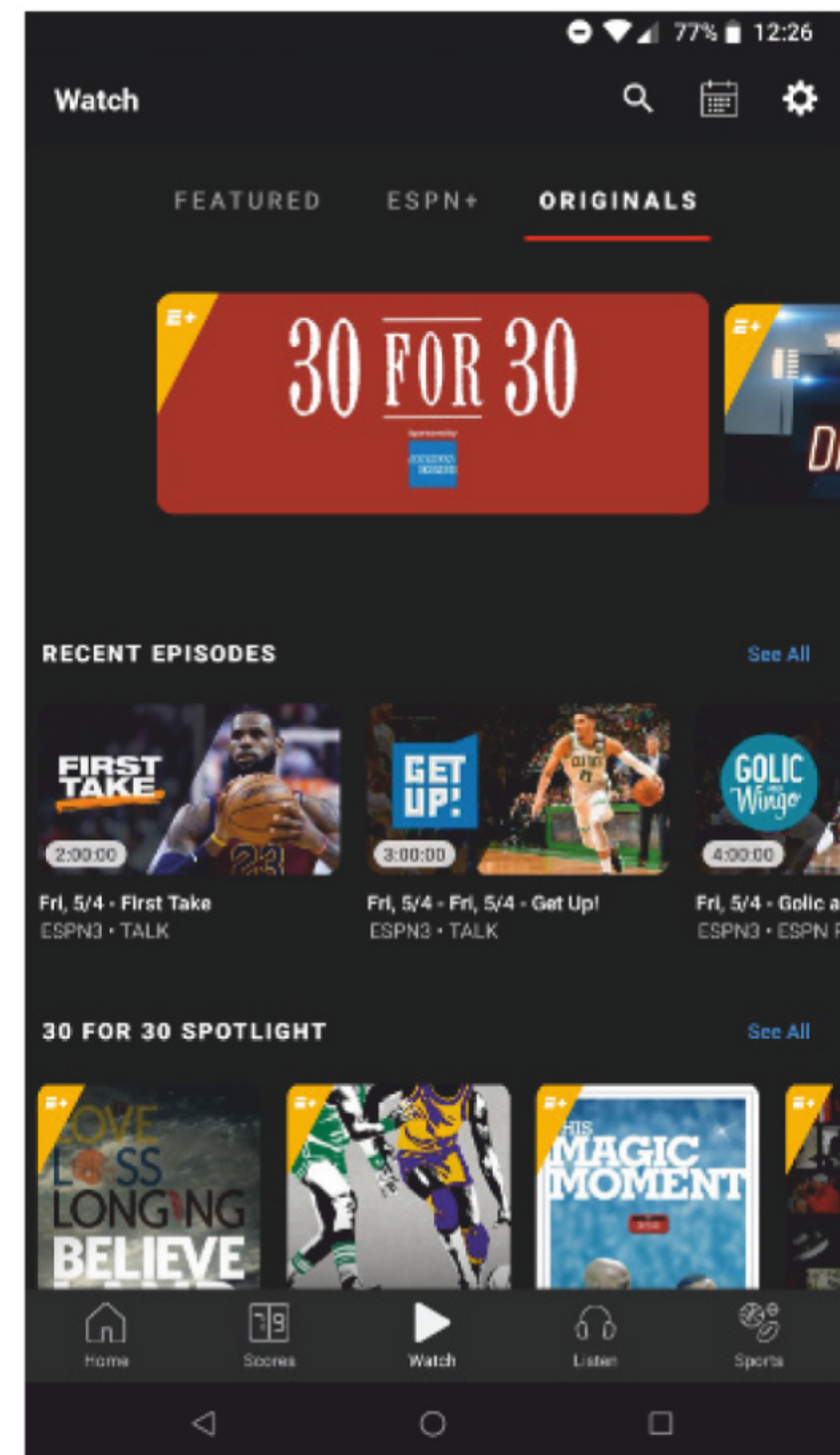
“Cable or satellite by its very nature is one-dimensional communication. You take a signal and distribute it out. The internet, by its very nature, is duplex,” said Inzerillo. “What I would say now versus when I said that quote originally is that the internet is a living, breathing thing, so it does adapt. There are lot of people working really hard to try to make it more suitable for the delivery of massive amounts of streaming media, because that’s the world we live in.”

CHAOS ENGINEERING

Streaming platforms need to prepare for every eventuality. As concurrent streams increase, the tech teams keeping the services running have turned to a process called “chaos engineering.” Netflix developed the term to describe deliberately running “chaos experiments” on a production system in order to find small problems before they can escalate into large ones that could take a service offline. It’s a similar concept to cybersecurity penetration testing or even bug bounty programs: Push a system to its limits and find the cracks to ultimately make it stronger.

Netflix built an open-source program called Chaos Monkey that randomly causes small-scale catastrophes by terminating instances in production during work hours, when engineers are available to track and fix issues. It’s designed not only to catch errors but also to help engineers figure out what the most critical parts of the system are and to build in redundancies to make them more resilient.

Hulu uses chaos engineering too, specifically around its live TV service. Soltanovich said that for events like the Super Bowl or March Madness, there’s no way to predict with complete certainty how many people will tune in. Chaos engineering keeps Hulu + Live TV ahead of the curve.



“We have a continuous process we’ve evolved over the past couple of years as we launched Live. On a daily or weekly basis, we’re pushing our servers to the boundaries,” said Soltanovich. “We want to understand where the weakest link is and improve our architecture and infrastructure.”

During Super Bowl 2019, the race to monetize Instagram’s World Record Egg—the photo of a brown egg that dethroned a Kylie Jenner pic as the most liked Instagram post of all time—culminated in a 30-second ad promoting mental health awareness. The ad was sponsored by Hulu.

On the Friday before Super Bowl Sunday, the egg’s Instagram account put up a teaser post: “The wait is over... All will be revealed this Sunday following the Super Bowl. Watch it first, only on @hulu.” Rafael Soltanovich said Hulu’s engineering team then had to prepare for viral Armageddon.

“The campaign went viral. It was announced that you would be able to watch the egg crack on Hulu exclusively after the Super Bowl, so we had to deal with a potential demand of over 50 million people hitting Hulu at once,” said Soltanovich. “There’s the engineering part of being prepared, and there’s the user experience part of how navigating [users through] a certain flow that makes smart use of our system. We absolutely chaos-tested for that one.”

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10 Tips for Acing Remote-Job Interviews

BY JILL DUFFY



Working remotely can be a great privilege, but you'll have to make an extra effort to do it successfully. Full-time remote workers are hyper-aware of how they communicate. They have unique etiquette for participation during meetings. They also face different questions and challenges than office-based workers. If you're a candidate for a remote position or just starting your search, knowing some of these details gives you a leg up when it comes to the job interview.

I've worked remotely in a few different roles. In one job, I started as a full-time local hire and negotiated a remote position when my partner was accepted to graduate school in the UK. I had another job that was a full-time remote position for a company of all remote employees. Also, any freelance writing I do is remote. From all these experiences, I've learned what remote organizations pay attention to when interviewing job candidates. These 10 tips will help you schedule, prepare for, and participate in a remote job interview.

SCHEDULING THE INTERVIEW

1. Be Clear, Concise, and Unironic in Writing

When applying for a remote position, you'll probably connect with the team by email first. Be aware that the people reading your application and email responses have heightened sensitivity to written language. It's a hot topic among remote workers, who must be extra conscientious of how they express themselves. Leave irony, jokes, and subtlety aside. Be as clear and concise as possible.

In remote work settings, every email and message must be clear in both content and tone. No one wants to read a message and be left wondering, "Is she annoyed with me? Should I do the work over again?" When people are separated by distance and time zones, one obscure message can easily fester into something no one intended it to be.

Start fine-tuning your sensitivity to the team's communication style right away. Do they use exclamation points and emojis to express joy and confusion, to clarify their tone? Pick up on it, and if you're comfortable with it, mirror it in your replies. The team will notice if you do, and they'll notice if you don't do it, too.



Be aware that the people reading your application and email responses have heightened sensitivity to written language.



2. Don't Respond to Every Email Immediately

Successful remote workers will tell you that finding work-life balance is key to contentment. When a team shows interest in you as a candidate, don't feel pressured into replying to every email the moment it arrives, especially when it's after hours.

How quickly you respond depends on context. If a non-urgent email hits your inbox at 9 p.m., wait until the morning to reply. That said, if you get an email in the evening about coordinating an interview the next day, time is of the essence, and people will be grateful if you respond sooner rather than later. When you reply to emails in a timely way but not obsessively late at night, you prove that you already have an understanding of work-life balance. That's a trait remote employers like to see.

3. Talk About Time Zones

When scheduling an interview for a remote job, talk about time zones. Mention your time zone using the correct terminology and note the difference from UTC, GMT, or your counterpart's time zone. Don't be afraid to look it up. Daylight savings time throws a wrench into the equation twice a year.

Let's say your contact is in Denver and you're in Brasilia. Write, "I'm on Brasilia Standard Time (GMT -3). That puts me 4 hours ahead of Mountain Standard Time. Can we have a call at noon MST (4 p.m. BST)?"

Always suggest and confirm times using both your contact's time zone and your own. It eliminates confusion and gives everyone an opportunity to catch a time-conversion error.

The image shows a digital interface for comparing times across different time zones. It features three rows, each representing a city and its time zone. Each row includes a flag icon, the city name, the time zone abbreviation and offset, the date, the time, and a green status indicator. At the bottom, there is a blue button with a plus icon and the text 'Add another city or time zone...'.

| City | Time Zone | Date | Time | Status |
|-------------------------|--------------|-----------------|-------|--------|
| Tel Aviv, Israel* | IDT (UTC +3) | Tue, 9 Apr 2019 | 18:00 | ● |
| London, United Kingdom* | BST (UTC +1) | Tue, 9 Apr 2019 | 16:00 | ● |
| New York, NY, USA* | EDT (UTC -4) | Tue, 9 Apr 2019 | 11:00 | ● |

+ Add another city or time zone...

4. Suggest Multiple Ways to Meet

When a potential employer asks your availability for an interview, suggest multiple ways to meet. Offer a phone number, Skype ID, Google Chat Hangouts name, WhatsApp number, and anything else that makes sense. The team may already have a preferred method for calls, but when you give several options, it shows that you're proactive when it comes to accommodating communication. Again, remote employers are sensitive to this fact and will notice it.



RIGHT BEFORE THE INTERVIEW

5. Prepare Your Space

Your interview for a remote job will almost certainly be via video conference call. Take a few minutes to prepare your space. Where will you sit? How close will your face be to the camera? Turn on your camera so that you can position your chair and frame your face. If you're on a laptop, prop it up a few inches so that you appear head-on rather than at an angle. Check the lighting so you're not backlit. Tidy up the area behind you, and silence your notifications.

In addition, if you'll be sharing any materials, such as a portfolio or work samples, be sure to send them ahead of time and have copies loaded on your computer. That way, you can easily share your screen if asked to do so.

6. Check Your Appearance, Camera, and Mic

Follow all the same advice you would for a traditional interview in terms of showing up early and dressing appropriately. The good news is you can stay barefoot and in sweatpants if you like, as no one will see your lower half.

Dressing up from head to toe, however, might make you feel more professional and confident. Keep it in mind as an option.

Use a headset and external microphone for remote job interviews. They improve the audio quality of call tremendously by eliminating feedback. You don't need anything fancy or expensive. A simple in-ear headphone set with a mic on the cord will do. Make sure your clothing and jewelry don't interfere with your headset.

Do not conduct a remote work job interview on a smartphone. Your potential colleagues expect you to have the capacity to work from home. They want to know you have a dedicated workstation.

7. Do a Test Run

At least 10 minutes before the call, run a test to ensure everything looks and sounds correct. Are you close enough to your Wi-Fi router, or do you need an ethernet cable? How does your mic sound? Some video conferencing services offer an A/V check that you can run yourself, such as Skype call testing service. If you can't check the quality solo, ask a friend to do a quick demo call. It shouldn't take more than a minute. Note that if you've never used the software or service that you'll be using for the interview, this step is critical, and you'll definitely want to do your test run as early as possible.



DURING THE INTERVIEW

8. Prove You're Cut Out for Remote Work

The interview gives you a chance to share information about yourself. Talk up your prior accomplishments as you would in any other job interview. Additionally, highlight experiences you've had with remote work. You want to illustrate you've done it before and were successful rather than simply say you're excited to try it.

If you don't have formal experience in a remote role, you can still use relevant examples. Did you work from home one day a week in your previous job? Did you write an entire Ph.D. thesis from your kitchen table? Even teaching could be relevant if you created lesson plans and graded papers at home. Think about those experiences and mention them.

9. In Groups, Mute Yourself

Remote teams hold a lot of meetings by video. On group calls, the protocol is to mute yourself when you're not talking. Showing that you know the etiquette for virtual meetings is tantamount to having good manners. It'll make a positive first impression.

For one-on-one calls, do not mute your mic unless there's unexpected background noise, like a garbage truck idling outside your window. In those situations, explain the reason you'll be intermittently muting. Otherwise, it can come off as fishy.

10. Ask Questions Pertaining to Remote Work

Working remotely has unique challenges and considerations. A serious candidate for a remote work position will have thoughtful questions ready to go about some aspects of working remotely. A few you can ask are:



At least 10 minutes before the call, run a test to ensure everything looks and sounds correct.



- How often does the team communicate, and does it tend to be synchronous or asynchronous?
- Are there regularly scheduled meetings? Do meeting times rotate to accommodate people in different time zones?
- What communication and collaboration tools does the team use? If you're not up on the latest collaboration software, be sure brush up on the subject before the call.
- What's the budget for home office equipment? Are there allowances for co-working space fees?
- How does the organization handle the onboarding of new hires?
- Is there any travel required, such as for training or team get-togethers, and if so, how often?
- How does the organization determine local holidays for time off (if the team is international)?
- What's the average number of sick days employees take?
- What does the organization do to keep employee morale high or develop cohesion among team members?
- What's security strategy for remote workers? Does the company require the use of a particular VPN service?

Knowing what makes remote work different and how sensitive remote employers are to these details can help you ace a remote job interview. Of course, all the other advice you've collected over the years about interviewing for a new job also applies. Be courteous and genuine. Prepare by researching the organization and what it does. Come up with questions about the day-to-day work and goals of the position. Make sure that during the interview, you assess whether you want to work for the organization and with the team, too.

Finally, be certain that working remotely is right for you. Not everyone thrives when they're in control of their work environment. If it's a good fit, however, then welcome to the club.

How to Spot Fake News Online

BY LANCE WHITNEY



Fake news has become a pervasive problem on the internet. You find a story online, but you don't know if you can trust it. Is it true? Accurate? Not even your Facebook friends know how to tell the difference.

You may not be able to identify each individual story as true or false, but you can find out whether the news site that published it is considered reliable and truthful. Plug-ins such as NewsGuard, TrustedNews, and the Official Media Bias Fact Check Icon integrate into your browser and display grades, rankings, and reports to tell you more about each news site you visit. You can then better determine if the stories you read across the internet should be trusted.

NEWSGUARD

NewsGuard relies on a team of journalists who analyze more than 2,000 news and information sites in the United States. Each site is evaluated and ranked on nine different criteria:

- Does the site repeatedly publish false content?
- Does it gather and present information responsibly?
- Does it regularly correct or clarify errors?
- Does it handle the difference between news and opinion responsibly?
- Does it avoid deceptive headlines?
- Does it disclose ownership and financing about itself?
- Does it clearly label advertising?
- Does it reveal who's in charge, including possible conflicts of interest?
- Does it provide information about content creators?

Each criterion is given a certain weighting, or number of points, to determine the site's overall rating. A site earns a green rating when it meets basic standards of accuracy and accountability. A site with a red rating means it fails to meet those minimum standards.

NewsGuard is available as a plug-in for Google Chrome, Microsoft Edge, Firefox, and Apple's Safari. On mobile, Microsoft Edge for iOS and Android has a built-in News rating setting in which you can enable NewsGuard.

After NewsGuard is activated, an icon for the plug-in appears on your browser's toolbar. Surf to a website that NewsGuard's team has analyzed, and the icon turns green or red, depending on the site's ranking. Click on the icon to find out why the site earned its color.

From there, clicking on the link to view the full nutrition label serves up greater details that reveal the ownership, content, history, background, and credibility (or lack thereof) of the site. The label also lists the authors behind the report and the sources they used.

Run a Google or Bing search, and NewsGuard displays its familiar icon next to any news sites or stories that appear in the results. Hover over the icon to view NewsGuard's analysis of the site.

TRUSTEDNEWS

Available just for Google Chrome, TrustedNews comes from Eyeo, the company behind the popular ad filtering plug-in Adblock Plus. TrustedNews works differently than NewsGuard because it doesn't recruit journalists to analyze news sites.

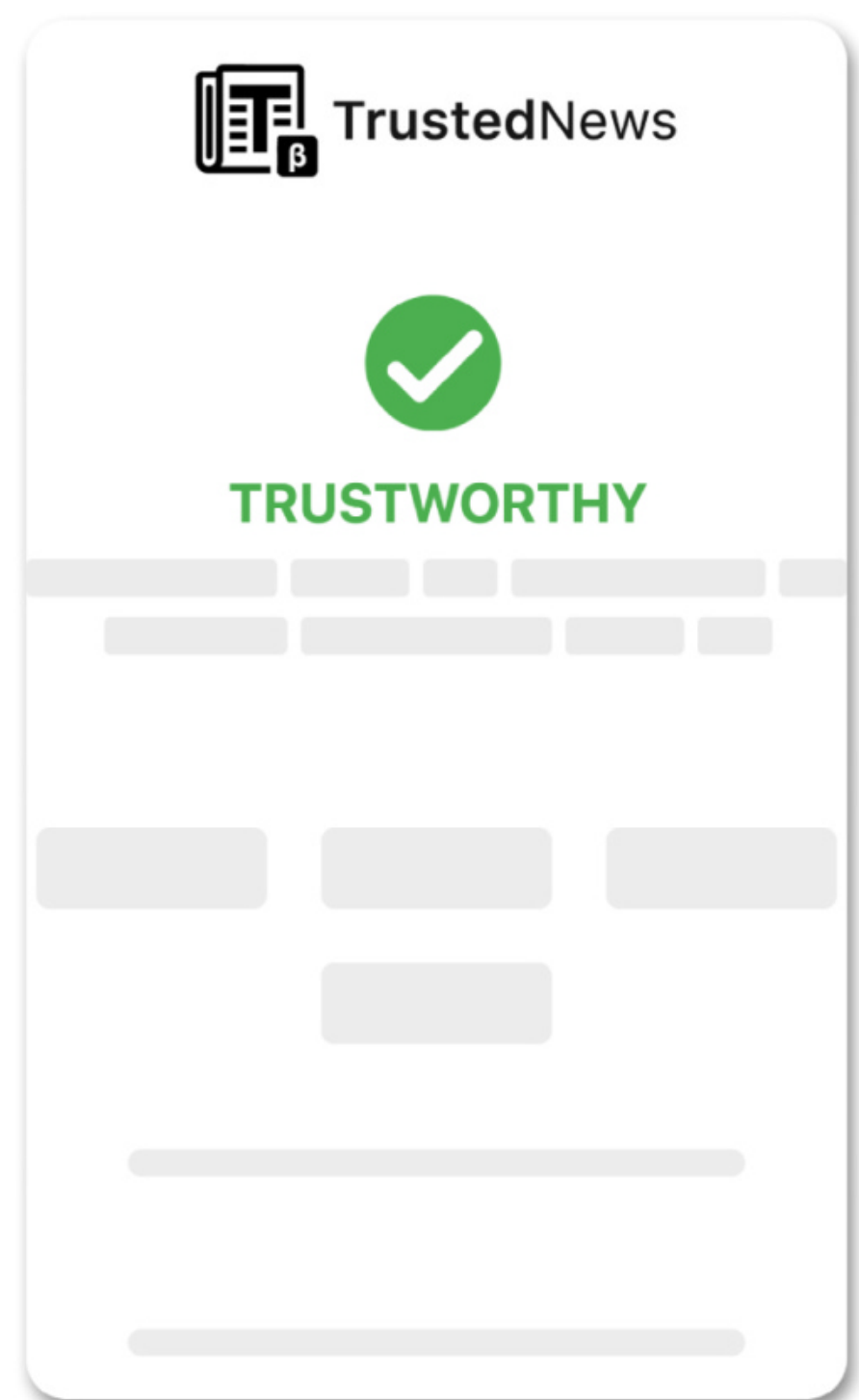
Instead, TrustedNews taps into MetaCert's MetaCert Protocol, which uses independent sources to gauge the accuracy and truthfulness of news content. Eyeo touts MetaCert as reliable, asserting that its sources aren't politically affiliated and are transparent in fact-checking.

Beyond MetaCert, TrustedNews relies on other sources to analyze news and information sites. One such source is Politifact, a fact-checking service run by The Poynter Institute, a nonprofit school for journalists. Another source is Snopes, which fights misinformation by employing writers, editors, and others to fact-check rumors and gossip.

A third source is Melissa Zimdars, Assistant Professor of Communication and Media at Merrimack College, who is known for compiling a list of fake news sources. Initially intended just for a class that Zimdars taught, the list has since gone viral.

The sources use specific criteria to analyze each site and to give it a certain rating or classification. Is the content based on facts and backed up by primary sources? If so, the site is considered Trustworthy. Does the site publish false or misleading information? If so, it's rated Untrustworthy.

If the site contains politically biased content or unproven and skewed views, it's rated as Biased. If it has misleading or false headlines designed to entice readers to visit the site, it's rated as Clickbait. And if the content is discovered delivering threats to your computer or personal safety, it's rated as Malicious.



To use TrustedNews in Chrome, download and install it from the Chrome Web Store. When you open a news site that TrustedNews has analyzed, its toolbar icon displays a small label indicating the site's rating. Click the icon, and the resulting window displays and explains the rating.

Click on the link for "Learn how we reached this rating." You'll find links to pages that explain the MetaCert protocol, how the sources rate websites, and why TrustedNews believe you should trust it.

You can also click on a link to give feedback on the rating. From there, indicate whether you agree or disagree with the rating and share your reasons why.

OFFICIAL MEDIA BIAS FACT CHECK ICON

The Official Media Bias Fact Check Icon, or MBFC, offers a different take than the other plug-ins. Instead of grading news sites on a variety of different criteria, MBFC focuses on one factor: political bias. But it also evaluates a site on factual reporting—how accurate and reliable the information is and how proper the sources are for that information.

“Instead of grading news sites on a variety of criteria, MBFC focuses on one factor: political bias.”

The screenshot shows the Media Bias/Fact Check website interface. At the top, the title "MEDIA BIAS/FACT CHECK" is displayed with the subtitle "The Most Comprehensive Media Bias Resource". Below this is a navigation bar with links: HOME, SEARCH, ABOUT, METHODOLOGY, MBFC NEWS, ORIGINAL ARTICLES/NEWS, APPS/EXTENSIONS, SUBMIT SOURCE, SOURCES PENDING, FACTUAL NEWS SEARCH, FILTERED SEARCH, RSS, HELP US FACT CHECK, and CORRECTIONS POLICY. A secondary navigation bar lists various bias categories: Left Bias, Left-Center Bias, Least Biased, Right-Center Bias, Right Bias, Pro-Science, Conspiracy-Pseudoscience, Questionable Sources, Satire, and (NEW) Re-Evaluated Sources. The main content area shows the search results for "Huffington Post (HuffPost)". A horizontal bias scale is visible, ranging from "Extreme Left" to "Extreme Right", with a yellow dot indicating the site's rating as "Left Biased". Below the scale, a text box explains the rating: "These media sources are moderately to strongly biased toward liberal causes through story selection and/or political affiliation. They may utilize strong loaded words (wording that attempts to influence an audience by using appeal to emotion or stereotypes), publish misleading reports and omit reporting of information that may damage liberal causes. Some sources in this category may be untrustworthy. See all Left Bias sources." A summary note states: "Overall, we rate HuffPost Left-Biased due to story selection that favors the left and factually High due to proper sourcing of information." On the right side of the page, there are links to "Donate" and "Become our patron on patreon", along with a "purple" promotional banner.

Available for Chrome and Firefox, this plug-in comes courtesy of developer Jeffrey Carl Faden, a software engineer at Lab Zero. The plug-in takes its name from—but is not affiliated with—a website called MBFC News, which has analyzed more than 2,600 news and media sites for political leanings and bias.

The Methodology section for the site explains the process MBFC employs to evaluate each news site, including the use of fact-checking principles developed by the Poynter Institute.

In a blog post from 2016, Faden revealed that he created the MBFC plug-in so he wouldn't have to consult the MBFC News website each time he wanted to check a news site. Like the MBFC site, the plug-in assigns rankings to news sites based on an analysis of bias. A site can receive any of the following grades:

L – Left Bias

LC – Left-Center Bias

C – Center (Least Biased)

RC – Right-Center Bias

R – Right Bias

PS – Pro-Science

CP – Conspiracy-Pseudoscience

S – SatireQ – Questionable Sources

After you install the MBFC plug-in, an icon appears on the toolbar or toward the end of the address bar. Browse to a news or information site, and the icon changes its color and initial to indicate the bias ranking for that site.

Click on the icon, and a description pops up to explain the specific level of bias assigned to that site. The window also indicates the site's level of factual reporting—Very High, High, Mixed, Low, or Very Low.

Click on the More info link for the news site, and you'll see a detailed report with examples that explain why the site was evaluated with a certain bias. The report also includes a history and background of the site.

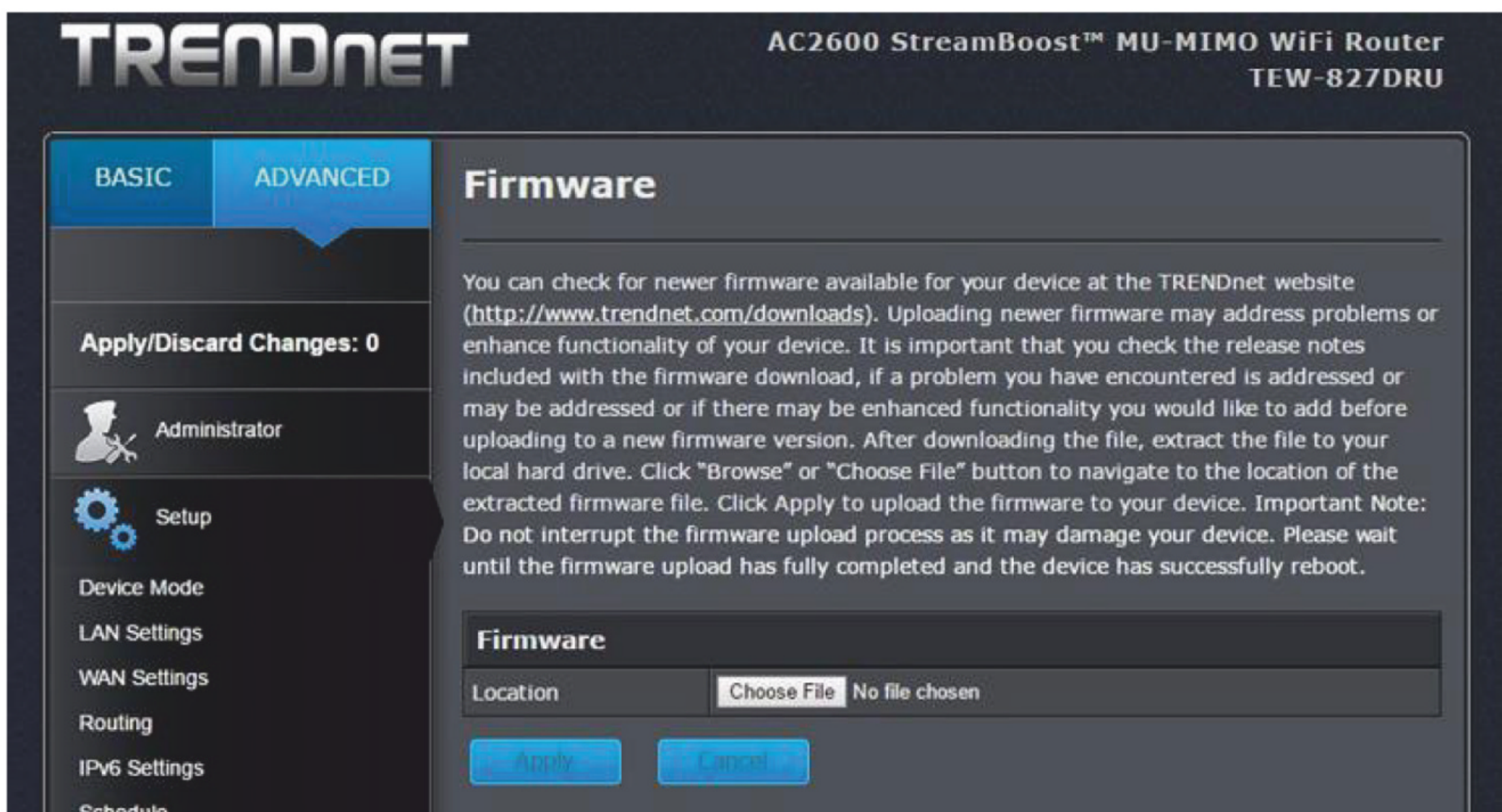
10 Ways to Boost Your Wi-Fi Signal

BY LANCE WHITNEY



Browsing slowing to a crawl, the inability to stream, dropped Wi-Fi signals, wireless dead zones—every one of these problems is maddening in a world where getting online has become as necessary as breathing. (Well, maybe not that critical—but important.)

If your Wi-Fi has gotten sluggish, you can find plenty of tools that'll test the speed of your internet. But if the only way you can get decent reception is by standing next to your wireless router, these simple tips can help optimize your network.



UPDATE YOUR ROUTER FIRMWARE

Perhaps your router just needs an update. Router manufacturers are always tweaking their software to eke out a bit more speed. How easy—or how difficult—it is to upgrade your firmware depends entirely on your device manufacturer and model.

Most current routers have the update process built right into the administration interface, so it's just a matter of hitting a firmware upgrade button. Other models, particularly if they're older, still require you to go to the manufacturer's website, download a firmware file from your router's support page, and upload it to the administration interface. It's tedious but worth doing. In fact, even if your wireless network isn't ailing, you should update your firmware on a regular basis for performance improvements, better features, and security updates.

ACHIEVE OPTIMAL ROUTER PLACEMENT

Not all rooms and spaces are created equal. The fact is, where you place the router can affect your wireless coverage. It may seem logical to have the router inside a cabinet and out of the way, or right by the window where the cable comes in, but that's not always the case. Rather than relegating it to a far end of your home, the router should be in the center of your house, if possible, so its signal can reach as far as possible.

In addition, wireless routers need open spaces, away from walls and obstructions. So while it's tempting to hide that ugly black box, you'll get better

signal when it's surrounded by open air (which should prevent the router from overheating, too). Keep it away from heavy-duty appliances and electronics as well, since running those in close proximity can impact Wi-Fi performance.

If your router has external antennas, orient them vertically to bump up coverage. If you can, it even helps to elevate the router—mount it high on the wall or on the top shelf to get a better signal. Plenty of tools can help you visualize your network coverage. I like Heatmapper and our Editors' Choice, inSSIDer, which shows you both the weak and strong spots in your Wi-Fi network. There are plenty of mobile apps, too, such as Netgear's WiFi Analytics.

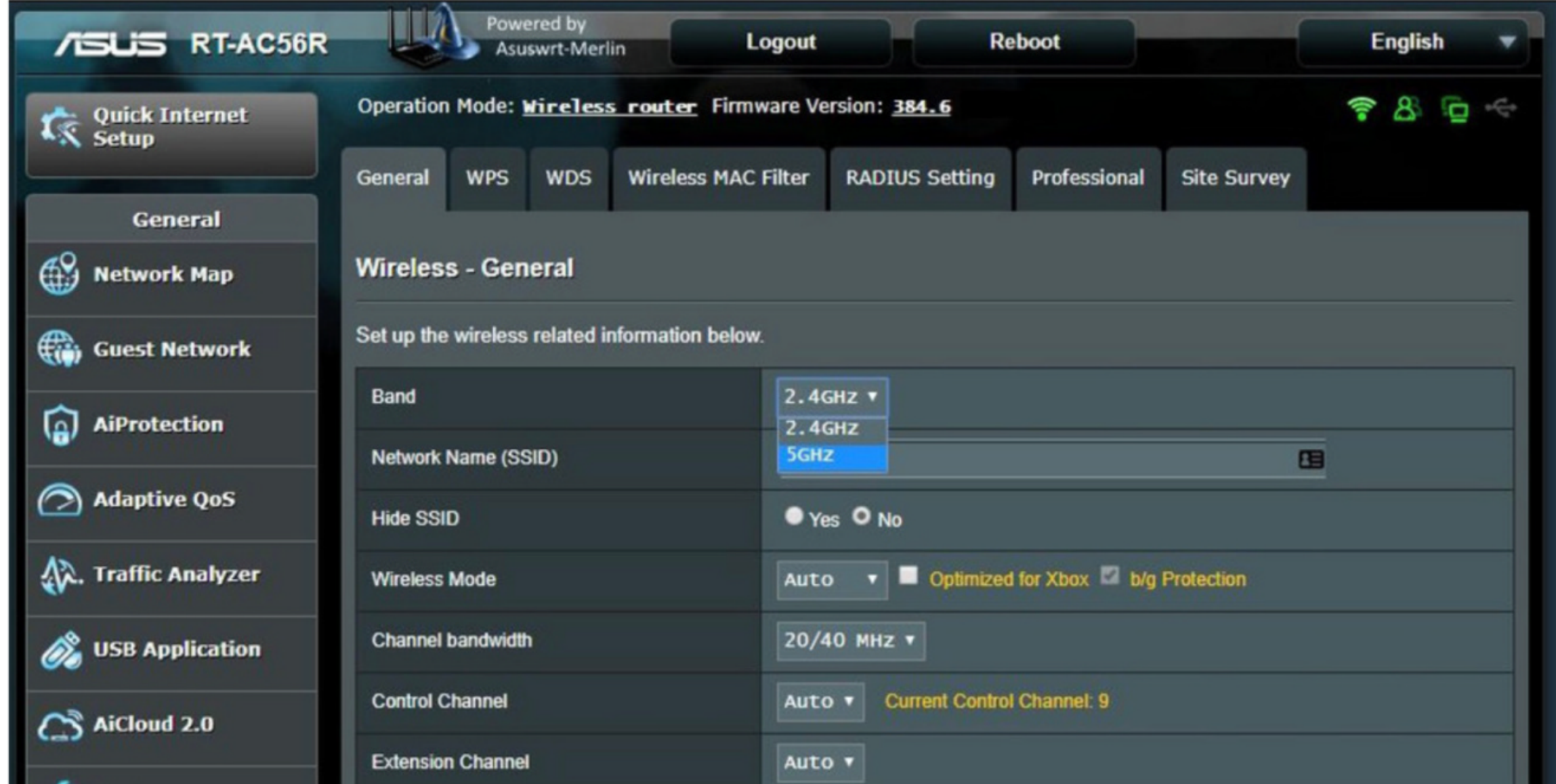
It's tempting to hide that ugly black box, but you'll get better signal when it's surrounded by open air.



WHAT'S YOUR FREQUENCY?

Take a look at your network's administrator interface, and make sure you have it configured for optimum performance. If you have a dual-band router, you'll likely get better throughput by switching to the 5GHz band instead of using the more common 2.4GHz band.

Not only does 5GHz offer faster speeds, but you'll likely encounter less interference from other wireless networks and devices since the 5GHz



frequency is not as commonly used. (It doesn't handle obstructions and distances quite as well as a 2.4GHz signal does, though, so it won't necessarily reach as far.)

Most modern dual-band routers should offer you the option to use the same network name, or SSID, on both bands. Check your router's administration interface, look for the 5GHz network option, and give it the same SSID and password as your 2.4GHz network. That way, your devices will automatically choose the best signal whenever they can. (If your router doesn't offer you the option to use the same SSID, just give it another name—like SmithHouse-5GHz—and try to connect to that one manually whenever possible.)

CHANGE THAT CHANNEL

Interference is a big issue, especially for those who live in densely populated areas. Signals from other wireless networks can impact speeds, not to mention some cordless phone systems, microwaves, and other electronic devices.

Ever play with walkie-talkies as a kid? You'll remember how the units needed to be on the same "channel" for you to hear one another. And if you happened to be on the same channel as your neighbors, you could listen in on someone else's conversation, even if they were using a completely different set.

In the same vein, all modern routers can switch across different channels when communicating with your devices. Most routers will choose the channel for you, but if neighboring wireless networks are also using the same channel, then you are going to encounter signal congestion. A good router set to Automatic will try

to choose the least congested channel, but many cheaper routers will just choose a predefined channel, even if it isn't the best one. That could be a problem.

On Windows-based PCs, you can see which channels neighboring

Wi-Fi networks are using. From the command prompt, type *netsh wlan show all* and you'll see a list of all wireless networks and the channels being used in your vicinity.

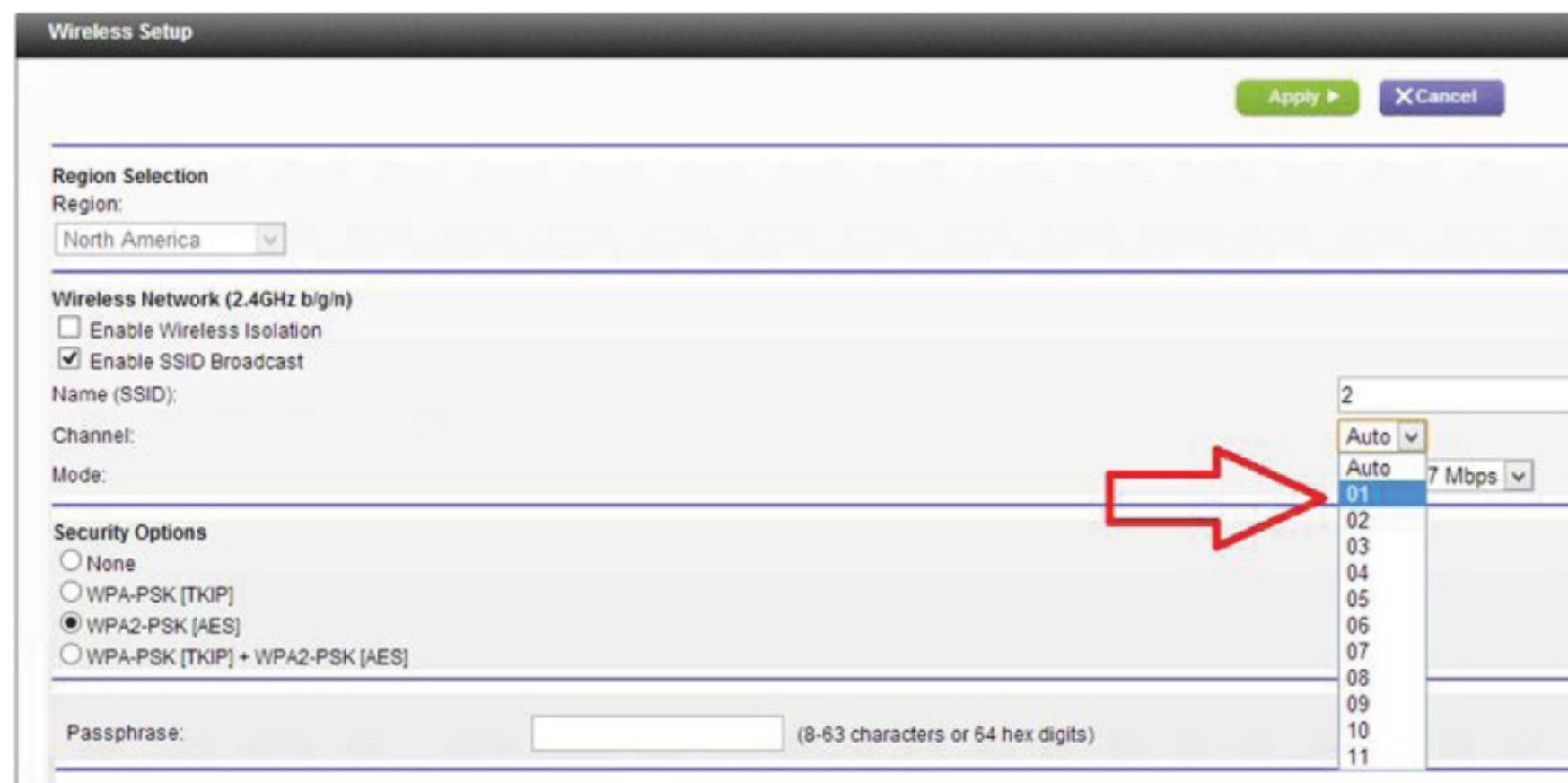
At PCMag, for instance, most of our networks and those of our neighbors are using channels 6 and 11. In general, for 2.4GHz, you want to stick to channels 1, 6, and 11 since they're the only ones that don't overlap with other channels (which can degrade performance). 5GHz generally uses non-overlapping channels, however, which should make selecting the right one much easier.

If the Auto setting isn't working well for you, sign into your router's administrator interface, head to the basic wireless category, and try selecting one manually (ideally, one that isn't in use by many networks in your area). See whether that provides a better signal and faster speeds over the Automatic setting. Keep in mind that channel congestion can change over time, so if you choose a channel manually, you may want to check in once in a while to make sure it's still the best one.

It's also possible the problem isn't interference or other networks. Is there a chance you have unwanted guests piggybacking on your network? If it's an open network, close it and set up a strong password—preferably WPA2, as WEP is notoriously easy to crack—so others can't join in.

CONTROL QUALITY

Most modern routers come with Quality of Service (QoS) tools to limit the amount of bandwidth that apps use, like the Netgear menu below.



For example, you could use QoS to prioritize video calls over file downloads—that way, your call with Grandma won't drop just because someone else is grabbing a big file from Dropbox. (Sure, their file will take longer, but Grandma is more important.) Some QoS settings even allow you to prioritize different apps at different times of day.

QoS settings can typically be found within advanced settings in the network's administrator interface. Some routers may even make using them easier by offering a one-click multimedia or gaming setting, so you know those applications will be prioritized.

DON'T RELY ON OBSOLETE HARDWARE

It's a good idea to get the most out of your existing equipment, but if you're running old hardware, you can't expect the best performance. We have a tendency to subscribe to the "if it ain't broke, don't fix it" mentality with back-end devices, especially networking gear. However, if you bought your router years ago, you might still be using the older, slower 802.11n standard (or God forbid, 802.11g).

These wireless standards cap at fairly low bandwidths. So all the tweaking we've outlined above will only get you so far—the maximum throughput for 802.11g is 54Mbps, while 802.11n caps out at 300Mbps. The latest 802.11ac supports 1Gbps. Our list of the best wireless routers is a good place to start the search for a faster router.



Even if your router is new, you might have some ancient devices that are falling back to older, slower standards. If you bought a PC within the last couple of years, you likely have an 802.11ac wireless adapter, or at least 802.11n. But the older your devices, the less likely they are to have modern tech built in. (You might be able to buy a USB Wi-Fi adapter that makes things run a bit better on those old machines.)

Remember, a higher-quality router won't just support those faster standards—it'll also do all the things we've outlined above better. It'll perform better channel selection and band steering for 5GHz devices, and it'll have better QoS features.

Others may have features such as Multi User-Multiple Input Multiple Output (MU-MIMO), including the Netgear Nighthawk X10 AD7200 Smart WiFi Router. MU-MIMO routers can send and receive multiple data streams simultaneously to multiple devices without bandwidth degradation and require specialized testing with multiple clients, but the clients need to be MU-MIMO compatible.

REPLACE YOUR ANTENNA

If your router uses an internal antenna, adding an external one would be a good idea, as the latter tends to send a stronger signal. Your router may have come with antennas you can add on yourself, but if not (or if you threw them away long ago), many router manufacturers sell antennas separately.

In many cases, you can choose between omnidirectional antennas, which send a signal to all directions, or directional ones, which send a signal in one specific direction. Most built-in



Even if your router is new, you might have some ancient devices that are falling back to older, slower standards.



antennas tend to be omnidirectional, so if you're buying an external one, it should be marked "high-gain" to actually make a difference.

A directional antenna tends to be a better option, since odds are that you aren't experiencing weak spots in your network in every direction. Point your external antenna in the direction of your weak spot, and it will broadcast the signal accordingly. Check your router manufacturer's website for details on what to buy.



SET UP A WIRELESS RANGE EXTENDER

Distance is one of the more obvious problems—there is a certain optimal range that the wireless signal can travel. If the network has to cover an area larger than the router is capable of transmitting to, or if there are lots of corners to go around and walls to penetrate, performance will take a hit. If you want to extend your signal, you'll need a range extender of some sort.

Range extenders look similar to standard routers but work differently. For starters, they pick up the existing Wi-Fi signal from your wireless router and simply rebroadcast it. As far as your network router is concerned, the range extender is just another client with an IP address, much like a laptop.

Even though a range extender isn't a router, you should still use the same rules for figuring out placement: The extender should be close enough to your main network router to pick up a solid signal but close enough to the weak spot so it can do its job.

The extended signal will almost never be as good as the original, but it's better than nothing—though if you can connect the extender with Ethernet or Powerline instead of wirelessly, it'll be much better.

Your extender doesn't have to be the same brand or model as your existing router, though in some cases, extenders of the same brand may offer extra features (like Linksys' MaxStream routers and their "seamless roaming").

Above all else, make sure you pick one that can broadcast an equivalent signal: don't buy an 802.11n extender if your router is on 802.11ac.

UPGRADE TO A MESH-BASED WI-FI SYSTEM

Range extenders help bring connectivity to dead zones, but wireless range extenders usually provide only about half the bandwidth as a primary router does. Also, they often require separate management from two different administration pages and can even force you to use two different SSIDs, which is a huge pain. If you want seamless connectivity everywhere in your house that's manageable from a simple smartphone app, consider upgrading your whole network to a mesh Wi-Fi system.

Designed to cover every corner of your house, mesh Wi-Fi systems aim to replace your router rather than just extend it. You connect one node directly to your modem, then place one or more satellite nodes around your house. The included app will walk you through the setup, ensuring each node is placed in the ideal spot for the best signal.



The resulting setup blankets your house with a single wireless network that uses a single administration interface (in the form of a friendly mobile app), and often dedicates at least one wireless band to network backhaul, offering better performance than many extenders. Lots of mesh systems will even update your firmware automatically, so you always have the latest performance and security enhancements—no more downloading firmware from the manufacturer website.

The downside: Mesh Wi-Fi Systems aren't cheap, especially when you have a large home that requires multiple nodes. But if you're in the market for a new router anyway, they're worth considering.

GET INTO THE GUTS OF YOUR ROUTER

If you really want to get the most out of your current router and you're the adventurous type, you should look at the open-source DD-WRT router operating system. Many major router manufacturers, such as Linksys, Netgear, and TrendNET, offer routers that can run DD-WRT. Or you can simply download DD-WRT and install it on any compatible router you have lying around.

DD-WRT can ramp up performance and give you access to more advanced networking features, including virtual private networking (VPN), security, and granular customization. In fact, you can even install one right on your router.



Mesh Wi-Fi Systems aren't cheap, especially when you have a large home that requires multiple nodes.



Mapping State-by-State Tech Trends: Android vs. iOS

BY ROB MARVIN

Android vs. iOS State by State



The mobile OS duopoly is a fact of digital life. Smartphones and tablets in the US run on either Android or iOS, and the only questions left are who's winning and where.

PCMag surveyed 2,033 US consumers in February on a variety of tech topics, gathering additional demographic data including state-by-state. While the most recent comScore rankings show Android at 54.2 percent market share in the US and iOS at 44.8 percent as of December 2018, our survey found that only 14 states were predominately Android users compared to 36 for iOS.

Overall, 54 percent of respondents chose iOS as their smartphone OS of choice, 42 percent chose Android, 2 percent chose Other, and 2 percent chose None. Good for you, people off the grid.

The states where Android won out in our survey were primarily less populous ones, including Alaska, Arkansas, Hawaii, Kansas, Kentucky, Maine, Montana, and Wyoming. The states with the highest percentages of Android users were Wyoming at 66 percent and Hawaii at 61 percent, but most states had far closer breakdowns, with one OS ahead of the other by anywhere from 1 to 15 percentage points. The survey didn't take into account fragmentation, i.e. which versions of Android or iOS were installed.

For iOS, the most popular states were Connecticut at 73 percent of respondents, Missouri at 72 percent, and Mississippi at 71 percent. In the states with the highest populations densities, the races were a bit tighter, but iOS still wound up with sizable leads. In California and New York, iOS had 58 percent in both states to Android's 40 percent in CA (2 percent other) and 37 percent in NY (5 percent other.) Illinois was even wider at 63 percent for iOS and 33 percent for Android (4 percent other.)

The closest contests came in states including Colorado (49 percent iOS, 46 percent Android, 5 percent other), Kansas (Android 51 percent, iOS 49 percent,) Minnesota (iOS 49 percent, Android 47 percent, 4 percent other,) North Carolina (50 percent iOS, 46 percent Android, 4 percent other,) and Rhode Island (51 percent Android, 49 percent iOS.)

In some interesting demographic breakdowns, we found that 57 percent of iOS users are female versus 43 percent male. Breaking down age groups, we found that 70 percent of respondents ages 18 to 24 use iOS, while in the 55-to-64 age range, it was more distributed, with 49 percent using Android, 47 percent using iOS, and the other 4 percent choosing Other or None.

Looking from mobile to desktop operating systems, we also found that 63 percent of iOS users have Windows computers, and 34 percent have Macs (1 percent other). On the Android side, 90 percent of users have Windows desktops or laptops, and only 10 percent have Macs.



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